# THE CALIFORNIA DEPARTMENT OF FOOD AND AGRICULTURE
# HYDRILLA ERADICATION PROGRAM
# ANNUAL PROGRESS REPORT 2013

## *PROTECTING CALIFORNIA'S WATERWAYS*

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with the assistance of Program Staff

## INTRODUCTION

This report covers the work of the California Department of Food and Agriculture (CDFA) Hydrilla Eradication Program in 2013. It begins with an introduction to hydrilla and a brief history and overview of the program. A section follows on "highlights and lessons" of the season, touching briefly on events of most importance or interest. The report then describes each of the current active eradication projects in detail, including a section on CDFA's annual survey of the Sacramento/San Joaquin River Delta.

CDFA is the lead agency in California on hydrilla[1]. The Hydrilla Eradication Program's mandate is to protect the state's water systems from this weed by finding and eradicating it. As the lead agency, the CDFA runs the Program, but does so in cooperation with county agricultural commissioners and other federal, state, county and city agencies, Native American tribes and private individuals and entities. In addition, the Program received financial and in-kind support in 2013 from the California Department of Boating and Waterways, California Department of Water Resources, the Lake County Department of Agriculture, the Lake County Department of Public Works, and the Sutter-Yuba Weed Management Area. Unfortunately the United States Department of the Interior-Bureau of Reclamation was unable to grant funding to the project in 2013. The loss of this traditional funding source had an impact on the project.

The CDFA is committed to an 'early detection and rapid response' strategy for the eradication of hydrilla. When an infestation is found at an early stage, the population is still small, so eradication efforts cost less and result in less environmental impact than if infestations were detected later when populations are larger and more widespread. 'Rapid response' involves implementing the most effective eradication methods as quickly as possible. There are many examples of the Program's history of 'early detection and rapid response' and the CDFA considers this to be one of the keys to its success.

## THE THREAT OF HYDRILLA

Hydrilla (*Hydrilla verticillata*) is a non-native, aggressive, submerged water weed. Once hydrilla invades an aquatic ecosystem it drives out all native and introduced aquatic plants, creating a pure stand. Its competitive edge comes from several different mechanisms. For one, hydrilla can grow under lower light conditions than nearly any other species (only one percent of sunlight), allowing it to grow up underneath other plants and to survive at greater depths. Its ability to use low light lets it start photosynthesizing earlier in the morning than other plants. This allows it to capture most of the carbon dioxide that has entered the water during the night. For plants growing under water, the availability of carbon dioxide often limits their growth.

[1] California Food and Agricultural Code, Sections 6048 and 7271.

Hydrilla can use bicarbonate as a carbon source, in addition to carbon dioxide. When it uses bicarbonate it increases the alkalinity of the water which also inhibits native species.

Hydrilla has excellent survival and dispersal strategies. Seeds play a very small role in its spread, and most populations do not produce any seed at all. Instead, the plant breaks apart very easily and small pieces of stem, no more than one inch long, can produce entirely new plants. Hydrilla produces special survival structures on the stems (called “turions”) and roots (called “tubers”). The turions break off the stems in the fall and can drift for long distances before sinking to start a new plant. Each tuber produces a new plant and a single tuber can lead to the production of several hundred others in the course of one growing season. The tubers can survive for four to seven years in the sediment before sprouting, even if no water is present for much of that time. The long survival time of the tubers creates the major challenge in eradicating the plant.

Hydrilla’s speed of growth is also impressive. The plant is between 93 to 95 percent water, so it can create huge volumes of biomass with very few resources. As a result, it can grow very rapidly, doubling its biomass every two weeks in summer conditions. Hydrilla branches profusely as it approaches the water surface, densely filling the entire water column up to 20 feet deep and shading out other plants. Recent research has shown that, when a hydrilla plant begins to grow to the surface, it can grow 10 feet in eight days. The same study showed that on average, by the end of five weeks of growth, a single nine-inch rooted shoot (a stem with growing tip), produces a total of over 3,200 inches (267 feet) of stems and tips. This is an increase of 356 times in five weeks. This was, of course, under good growing conditions.

As a final competitive edge, when hydrilla was introduced into the United States, it came without the various natural enemies that evolved with it, such as insects and diseases specialized for attacking it. It grows very aggressively in a wide variety of water conditions and temperatures, so few habitats are safe from it. The tangled mats that it forms have a variety of economic and ecological impacts.

Many of the potential economic impacts of hydrilla have not been fully studied, but even if a small fraction of the potential were realized the results would be very alarming. In particular, mats of hydrilla can reduce the flow of water in canals and ditches up to 85 percent, which would devastate a society that survives by moving large amounts of water. Similarly, the mats can clog and damage dams, power plants and other water control structures. In one documented instance, hydrilla blocked the intakes of the St. Stephen hydroelectric facility on Lake Moultrie, South Carolina, in 1991, forcing repairs and causing loss of power generation that cost $4,650,000. In addition, the infestation cost $1.2 million for emergency treatment alone. Hydrilla seriously interferes with boating and fishing and heavy hydrilla infestations decrease fishing stocks. The plant can also increase the risk of drowning. These various impacts can seriously damage tourism and the economies it supports. In one analysis, hydrilla coverage increased 400 percent between 1983 and 1992 on Lake Seminole in Georgia, leading to reduced tourism with an estimated loss of about $13 million per year to the local economy.

The ecological impacts of hydrilla are several. Because of its rapid and dense growth, it drives out all other plant species and destroys any existing native plants. Many people do not realize this but plants only give off oxygen and use $CO_2$ when there is light, which is to say, in the day time. At night, plants use oxygen and give off $CO_2$, just like animals. Beneath a heavy stand of hydrilla, oxygen levels in the water fall so low at night that fish could not survive there very long. Similar effects on oxygen and acidity can contribute to increased releases of nutrients from

sediments. Such increases can lead to algae blooms and die-offs, which are signs of a polluted lake.

Aside from effects on water chemistry, the dense mass of plant material in the water alters habitat structure and food-web relationships for fish, which can lead to changes in fish populations. For instance, sunfish and bass are ambush-type predators that attack from cover. Increased plant cover can lead to larger numbers of these species, which can lead to lower salmon and trout populations. At some point, hydrilla infestations become so dense that they even interfere with hunting by bass and sunfish so fish populations tend to decline in general in very heavy infestations.

Although some birds feed on hydrilla, generally bird populations also decline in a heavily infested area. Through a biological quirk, hydrilla even threatens bald eagles. Hydrilla encourages the growth of certain toxic blue-green algae. Coots eat the hydrilla contaminated by the toxic algae, and then eagles eat the poisoned coots. Biologists have documented over 100 eagles killed by toxic prey animals.

Fishermen and wildlife enthusiasts sometimes argue that hydrilla improves habitat for fish and other wildlife. While it is true that initially some cover with hydrilla, up to 30 to 40 percent of an area, will often provide food and shelter for various animals, the plant does not often stay at a population level where it is helpful. Instead, it continues to expand until it monopolizes nearly every resource for itself. In addition, there are native species of underwater plants that are just as good or better for wildlife without the threat of runaway population explosions.

Hydrilla has two forms, monoecious and dioecious. The definition of the two forms depends on the distribution of male and female flowers among the individual plants, but more importantly for human concerns, they also have differing and complementary environmental requirements. The monoecious form appears to prefer more northern conditions, while the dioecious form is prevalent in the south. Both forms seem to do well in much of California.

## HISTORY AND OVERVIEW OF THE PROGRAM

Hydrilla has been found in various places in the United States as well as California. The dioecious[2] form of hydrilla was first identified in Florida in the 1960's, where it is believed to have been introduced in the 1950's. The infestation spread rapidly throughout the southeastern states and into Texas and Arizona. The dioecious form first appeared in California in 1976 in a 31-acre man-made lake in Marysville in Yuba County. The monoecious form was first detected in the United States in the Potomac River, near Washington, D.C., in the 1980's. It has since spread into a number of the southern and eastern states, into Washington State, and was first found in California in 1993 at an aquatic nursery in Visalia in Tulare County.

In 1977, after the first California hydrilla find, the California Legislature mandated[3] that the CDFA Secretary initiate a survey and detection program for hydrilla and eradicate it wherever

[2] The dioecious form of hydrilla has flowers of one sex only on each genetic individual. Monoecious individuals have individual flowers with only staminate or pistillate parts, but these occur on the same plant. Dioecious plants often branch freely near the water surface, forming large submerged mats near the water surface. In contrast, monoecious plants tend to branch freely near the rooting point, producing many stolons and a forest of vertical shoots, which can fill the entire water column with plant material. The genetic or ecological significance of this apparent dimorphism is unknown.

[3] California Food and Agricultural Code Article 9, Section 6048.

feasible[4]. In 1985, after hydrilla was found in Redding next to the Sacramento River, the Governor of California declared a "State of Emergency" for the eradication of that infestation[5]. In 1994, the CDFA Secretary also declared an "emergency situation" for the hydrilla infestation discovered that year in Clear Lake[6]. Similar declarations have been issued for most of the current hydrilla infestations[7].

Since 1976, hydrilla has been introduced into California waterways 29 separate times in 18 counties[8] (not counting detections in plant nurseries-see below). Of these 29 separate hydrilla introductions, the Hydrilla Eradication Program has eradicated hydrilla from 20 sites in the following 14 counties: Los Angeles, Madera, Mariposa, Monterey, Riverside, San Bernardino, San Diego, San Francisco, Santa Barbara, Shasta, Sonoma, Sutter, Tulare and Yuba (Table 1, Plate 2). The Hydrilla Eradication Program is currently eradicating[9] hydrilla from six locations in the following four counties: Lake, Nevada, Shasta, and Yuba. In 2010, with the declaration of eradication of the Chowchilla River / Eastman Lake infestation, Madera and Mariposa Counties move from the "infested" to the "eradicated" category. In 2013 eradication was declared for the two infestations in Calaveras County and the infestation in Tulare County.

Plate 1. The "hydrilla hook", a small grappling hook, with hydrilla

Hydrilla has been detected in plant nurseries and aquaculture vendors five times, the last two occurring in 2004. In March 2004, hydrilla was detected in a plant nursery in northern Los Angeles County and in November 2004, hydrilla was also detected in an aquaculture wholesaler in Alameda County. In each case the county department of agriculture took the lead on removing all hydrilla plants and plant parts from the infested area, and the CDFA Pest Exclusion Branch and Hydrilla Eradication Program personnel worked with the vendor to prevent reintroductions.

In 2013, 40 hydrilla plants were intercepted on an incoming shipment from Waterscapes aquatic in Florida (PDR # 360P06176323).

Every year, Program crews survey all known infested waterways and many high-risk lakes[10], ponds, reservoirs, streams, canals and other waterways in the state. High-risk areas include the Sacramento/San Joaquin River Delta and other high recreational-use water bodies and waterways

[4] A Hydrilla Science Advisory Panel was convened after each hydrilla outbreak. These panels have always found hydrilla eradication to be feasible.

[5] "Proclamation of a State of Emergency," issued by Governor George Deukmejian, October 23, 1985; terminated October 23, 1989.

[6] "Proclamation of a Project Regarding the Eradication of Hydrilla," issued by CDFA Secretary Henry Voss, August 12, 1994.

[7] Calaveras, Madera, Mariposa, Nevada, Shasta, and Tulare counties.

[8] The CDFA considers hydrilla infestations to be separate introductions if they appear more than two or three years apart.

[9] California Code of Regulations, Title 3, Division 4, Sections 3281 and 3410; California Code of Regulations, Section 3962; CDFA Plant Quarantine Manual, Section 3410.

[10] High-risk lakes, streams, etc. are those within five miles of Clear Lake, one mile either side of the Sacramento River near the Riverview Golf Course, three miles of the Yuba canal, and one mile of Bear Creek, the west fork of the Chowchilla River, and the Springville ponds.

within quarantine zones[11]. Surveys generally employ two methods. Working from either the shore or from boats, crew members visually scan the water surface and water column for suspicious plants. They supplement the visual scan by throwing a small grappling hook (Plate 1), which is dragged along the bottom and through the water to snag any long-stemmed vegetation such as hydrilla. Occasionally, divers conduct underwater surveys[12]. Surveys generally start when the water temperature climbs above 10 degrees Celsius[13] (50 degrees Fahrenheit[14]) in the spring and streams fall to a safe level. They generally end when water temperatures fall below 10 degrees Celsius in the fall. Active growth of hydrilla occurs between 10 degrees Celsius and 35 degrees Celsius (DiTomaso and Healy 2003, page 102). The Hydrilla Eradication Program also follows up on all reports from the public on potential new infestations. The last finds of hydrilla were in 2004 and 2005 when three infestations appeared in Nevada County. In the field no new hydrilla infestations have appeared since then though shipments containing hydrilla continue to be intercepted through regulatory inspection and exclusion activities.

The Hydrilla Eradication Program uses an integrated pest management approach to eradicate hydrilla. In 2013, the Program used (alone or in combination) manual removal, small scale dredging, lining of water bodies, biological control and aquatic herbicides. The major aquatic herbicide was a fluridone slow-release pellet formulation[15] applied at 90 or 150 ppb[16], depending upon the size of the water body. This season a new formulation of fluridone was used in some areas. The new product, Sonar H4C, contains a lower concentration of fluridone than the Slow Release Pellet (SRP) formulation and is one-half the length. The lower quantity of fluridone per pellet requires a larger number of pellets be dispersed to achieve the same concentration of active ingredient per unit area. The intention is to reduce the space between fluridone emitting pellets and increase the likelihood of a pellet landing near a potential plant. Other herbicides used in particular situations include a copper ethylenediamine liquid formulation[17] (applied at one ppm[18]) and a fluridone liquid formulation[19]. In addition, an experiment was conducted in conjunction with University of California Davis and chemical manufacturer United Phosphorus, Inc. on the use of an endothall-based herbicide as an additional product for hydrilla eradication. In the past, the Program has also used water draw down and drying of the hydrosoil followed by soil fumigation, large and small scale dredging, and burying.

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[11] Quarantine zones are established by declaration of the CDFA Secretary and are areas within eradication areas that have restrictions as to water use, access, or the intensity of survey.

[12] Surveys are conducted by two methods, visual search of the water column and physical samples. Trained biologists and support staff conduct visual searches to locate individual plants or mats that are visible in the water column or on the water surface. The crews conduct the visual searches from boats, canoes, or kayaks; by wading in shallow streams and lakesides; and by swimming using sight buoys and face masks, depending upon the circumstances. Because visual searches from the surface are sometimes hampered by poor visibility, the Program occasionally contracts divers for underwater surveys. Physical samples are taken using a modified grappling hook, usually thrown from a boat or canoe. Personnel trained in identifying hydrilla carefully examine the retrieved plant material. In either case, visual searches or bottom samples, if hydrilla is found, the number of plants or size of the infestation is recorded along with the physical location (by using a global positioning system technology and measured from known landmarks). Representative specimens from new locations are sent to the CDFA Plant Pest Diagnostic Center, Botany Laboratory for confirmation.

[13] C = Centigrade

[14] F= Fahrenheit

[15] Sonar® SRP brand, SePRO Corporation.

[16] One ppb = one part per billion = one microgram per liter.

[17] Komeen® brand, Griffin Corporation.

[18] One ppm = one part per million = one milligram per liter.

[19] Sonar® AS brand, SePRO Corporation.

Based upon recommendations from science advisory panels, the Hydrilla Program has generally followed a standard protocol in determining eradication. Program staff intensively treat and survey an infested site for a minimum of three growing seasons after the last hydrilla detection, followed by a minimum of another three seasons of intensive survey without treatment. Therefore, the CDFA considers hydrilla eradicated from a site only after a minimum of six years without finding any plants. Longer periods of negative surveys may be warranted, depending upon the circumstances.

In October 2009, the Technical Advisory Panel suggested that three years of follow-up treatment is probably not long enough, especially in large infestations and when depending solely on herbicides. This is because herbicides do not affect the dormant tubers. An herbicide must simply lay in wait for the tubers to sprout and the plants to appear above the sediments. It is unclear just how long tubers can remain dormant, but four to seven years is an often quoted figure. The 2009 panel suggested that eradication should not depend on any fixed time criterion for follow-up treatment. They suggested instead of trying to follow tuber health and depletion in the eradication site, using the disappearance of tubers as a guide for the time of follow-up treatment. This approach presents challenges, both in accurately following tuber depletion and in relating this to the absolute absence of plants. It is not uncommon in tuber surveys to take a large number of random sediment cores without finding any tubers, yet plants may be clearly visible in the area. However, the suggestion is a worthy one, as any information about tuber depletion is clearly better than none.

In addition to surveying and treating for hydrilla, the Hydrilla Eradication Program monitors aquatic herbicide concentrations in water in order to protect the state's waters. The CDFA performs monitoring as policy, and also to comply with the National Pollution Discharge Elimination System (NPDES) General Permit issued by the State Water Resources Control Board. The NPDES is a provision of the Clean Water Act to regulate and protect "waters of the United States" from pollution caused by point sources. This system was extended to aquatic pesticide applications by the Ninth Circuit of the United States Court of Appeals in its decision in *Headwaters, Inc. et al. v Talent Irrigation District*, March 12, 2001. To comply with the NPDES General Permit, the Hydrilla Eradication Program monitors fluridone concentrations in Clear Lake, copper concentrations in Clear Lake, diquat concentrations in Grasslands Wildlife Area Spongeplant ponds near Gustine and triclopyr concentrations in Clear Lake. The Hydrilla Eradication Program also monitors individual treatments to confirm that concentration targets are attained and at the request of the public in regards to the use of treated water. The monitoring results for the NPDES General Permit are published in a separate report.

The status of all current and historical sites in the Hydrilla Eradication Program is summarized in Table 1 and Plate 2.

**Plate 2: Current Hydrilla Eradication Projects, 2012**

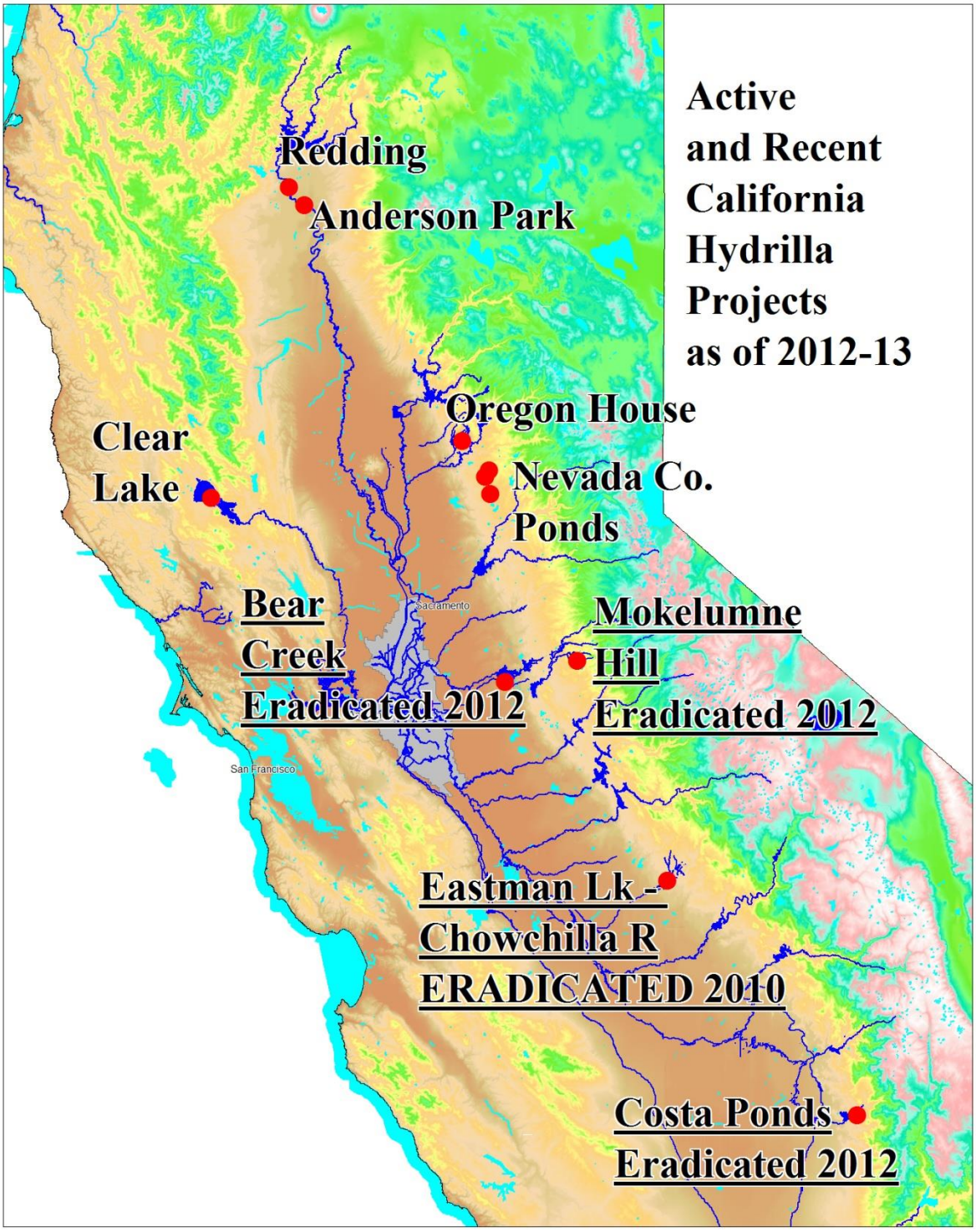


**Table 1: Status of Hydrilla in California, by County, 1977 – 2013**

| COUNTY | YEAR * | DESCRIPTION OF WATERWAY | SIZE | STATUS** |
|---|---|---|---|---|
| Calaveras | 1988 | Bear Creek, Units 2 to 11 | 5 miles | Declared eradication 2013 |
| | 1988 | Stock Pond | 0.5 acres | Declared eradication 2013 |
| | 1996 | Bear Creek, Unit 1 | 0.75 miles | Declared eradication 2013 |
| Imperial | 1977 | Imperial Irrigation System | 270 acres of ponds, 600 miles of canals, drains | Eradicated Survey |
| Lake | 1994 | Clear Lake | 739 of 43,000 acres | Active |
| Los Angeles | 1980 | Eight ponds | 2 acres | Eradicated |
| | 1983 | One pond | < 1 acre | Eradicated |
| | 1985 | One pond | < 1 acre | Eradicated |
| | 2004 | One pond (nursery) | < 0.5 acre | Eradicated |
| Madera/ Mariposa | 1989 | Eastman Lake /Chowchilla River | 1800 acres and 26 miles of river | Eradicated |
| Monterey | 1978 | Pond | 0.01 acre | Eradicated |
| Nevada | 2004 | One pond | 0.6 acres | Active |
| | 2005 | Two ponds | 2.8, 0.1 acres | Active |
| Riverside | 1977 | One pond | < 1 acre | Eradicated |
| | 1984 | One pond | < 1 acre | Eradicated |
| | 1985 | Three ponds | < 1 acre | Eradicated |
| San Bernardino | 1988 | One pond | < 0.01 acre | Eradicated |
| San Francisco | 1988 | One pond | 2 acres | Eradicated |
| San Diego | 1977 | Lake Murray | 160 acres | Eradicated |
| | 1977 | One pond | <1 acre | Eradicated |
| Santa Barbara | 1977 | One pond | 0.12 acre | Eradicated |
| | 1993 | One pond | < 0.01 acre | Eradicated |
| Shasta | 1985 | Seven ponds | 133 acres | Eradicated |
| | 1986 | Four ponds | 23.5 acres | Eradicated |
| | 1994 | Two ponds | 13 acres | Active |
| | 1996 | Four ponds | 39 acres | Active |
| Sonoma | 1984 | Spring Lake | 72 acres | Eradicated |
| Sutter | 1985 | One pond | < 0.01 acre | Eradicated |
| Tulare | 1993 | Three ponds | 0.6 acre | Eradicated |
| | 1996 | Seven ponds | 20 acres | Declared eradication 2013 |
| Yuba | 1976 | Lake Ellis | 30.8 acres | Eradicated |
| | 1990 | One pond (Shakey's) | 6 acres | Re-activated 2007 |
| | 1997 | 14 ponds | 20 acres | Active |
| | 1997 | Canal | 3 miles | Active |

*Year first detected at a given site.
**Eradicated = No hydrilla found at site in six or more years of intensive survey following the last treatment.
Survey = No hydrilla found at site in last three to six years, intensive surveys continue.
Active = Hydrilla detected within the last three years, an active treatment program continues.

## 2013 SEASON HIGHLIGHTS AND LESSONS

1) Three more hydrilla projects reached the threshold for eradication. At the end of the 2012 season, eight years had passed with no plants in the Mokelumne Hill and Bear Creek infestations in Calaveras County, and in the Costa Lakes infestation in Tulare County. These infestations were declared eradicated in early 2013.

2) As of the end of 2013, seven seasons with no plants have passed in Shasta County's Riverview Golf Course and Anderson City River Park infestations. The ponds had been under treatment with herbicide through 2011. 2013 was the second year of the non-treatment confirmation survey phase of the projects.

3) CDFA disbanded its longtime weed programs in 2011 due to declines in the State's General Fund, and with them went the six District Weed Biologists. The Weed Biologist in the Northwest District, Ed Finley, had been taking care of the hydrilla and spongeplant infestations around Redding, but that ended with his retirement as of June 30, 2011. His role has been picked up by Jonathan Heintz and David Kratville, working out of Sacramento, with help from the seasonal crews in Clear Lake or Fresno. The change in staffing led to a change in strategy for surveying the ponds. Rather than surveying lightly many times during the season, crews now visit the ponds only twice, in the first weeks of July and September. However, they spend several days surveying the ponds and adjacent waterways each time. No hydrilla was found.

4) There were six hydrilla plant detections in Clear Lake this year, down from 26 in 2012. Two of these finds were outside existing treatment areas. As a result 10.34 acres of treatment area were added. Another find was in a treatment area that had been pulled from treatment in 2013. As a result it was cycled back in to treatment for no change in acreage from 2012. The three other plant finds were in existing treatment areas. Floating fragments were found in one additional area but the rooted plant was never detected after multiple attempts, therefore a treatment area was not created. The number of new acres brought under treatment each year has been 350, 249, 120, 20, 10 and 26 acres in 2007, 2008, 2009, 2010, 2011 and 2012, respectively.

5) Yuba County – A new infested pond was found in the Oregon House area. The Trantham Pond measured 0.25 acres in size with an average depth of 3.25 feet. Six additional ponds (Citron, Clouse, Cornejo, Davis and Spiers 1&5) came back in to treatment as hydrilla was seen again after several years of no detection.

6) After the results of 2011 and in anticipation of starting to dredge in Clear Lake, the Program took some areas out of herbicide treatment in the 2012 season. All the candidate areas had been in treatment for at least four consecutive years and had gone at least four years without plants. About 90 acres were removed from treatment for the 2012 season. An additional 121 acres will be eligible for removal from treatment following the 2013 season.

7) In Nevada County, the Waste Transfer and Fairgrounds Ponds reached eight and seven years, respectively, without plants. 2013 was also the second year without treatment for the two ponds. They will remain under survey for at least another two years before declaring eradication. In Valkenburg Pond, three small plants were found in 2012, so treatments continued in this pond.

8) Unfortunately the dredging attempted in 2012 was not revisited in 2013. Plant fragments detected in 2013 were not able to be traced back to rooted plants for dredging.

9) In June 2013, the State Water Resources Control Board adopted the Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, Water Quality Order 2013-0002-DWQ, for the reissuance of General NPDES Permit CAG990005. Order 2013-0002-DWQ became effective on December 1, 2013. Existing dischargers were asked to make amendments to their Aquatic Pesticide Application Plans (APAP) to comply with the new order. The updated APAP was submitted to the State Water Resources Control Board on December 24, 2013 and will be posted for public comment.

10) In 2013 two new permanent employees began working for the Hydrilla Eradication Program. Mike Meske is an Agricultural Pest Control Specialist brought on in January of 2013 as the project lead for the Clear Lake Hydrilla Eradication Project out of the Lakeport, CA office. Mike started as an insect trapper in 2005 and worked his way up to project lead for the Pest Detection/Emergency Projects Branch working on the Asian Citrus Psyllid Project out of Camarillo, CA. Michelle Dennis began working for CDFA in 1993 as a Shipping Point inspector in the Central Valley. Michelle worked her way up to the level of Senior Agricultural Biologist Supervisor in charge of the Pierce's Disease Southern District for the Pest Exclusion Branch. Michelle briefly left State service to earn her Masters Degree in Plant Science from California State University, Fresno. Michelle began working with IPC in July 2013 and was responsible for updating the Hydrilla Eradication Program's Aquatic Pesticide Application Plan for the new National Pollution Discharge Elimination System permit.

11) The lease for the facility that had historically housed the Sacramento field staff was terminated in 2013 in order to reduce operating expenses for the Integrated Pest Control Branch. Staff spent the late fall and winter months disposing of old equipment and supplies. The now defunct Biological Control Program growing yard was cleaned of all left over equipment and handed over to Department of General Services. Resources were transferred to the Meadowview facility and later a storage unit in Yuba City. The Yuba City storage unit will now serve as the meeting point for the Yuba and Nevada County eradication project staff.

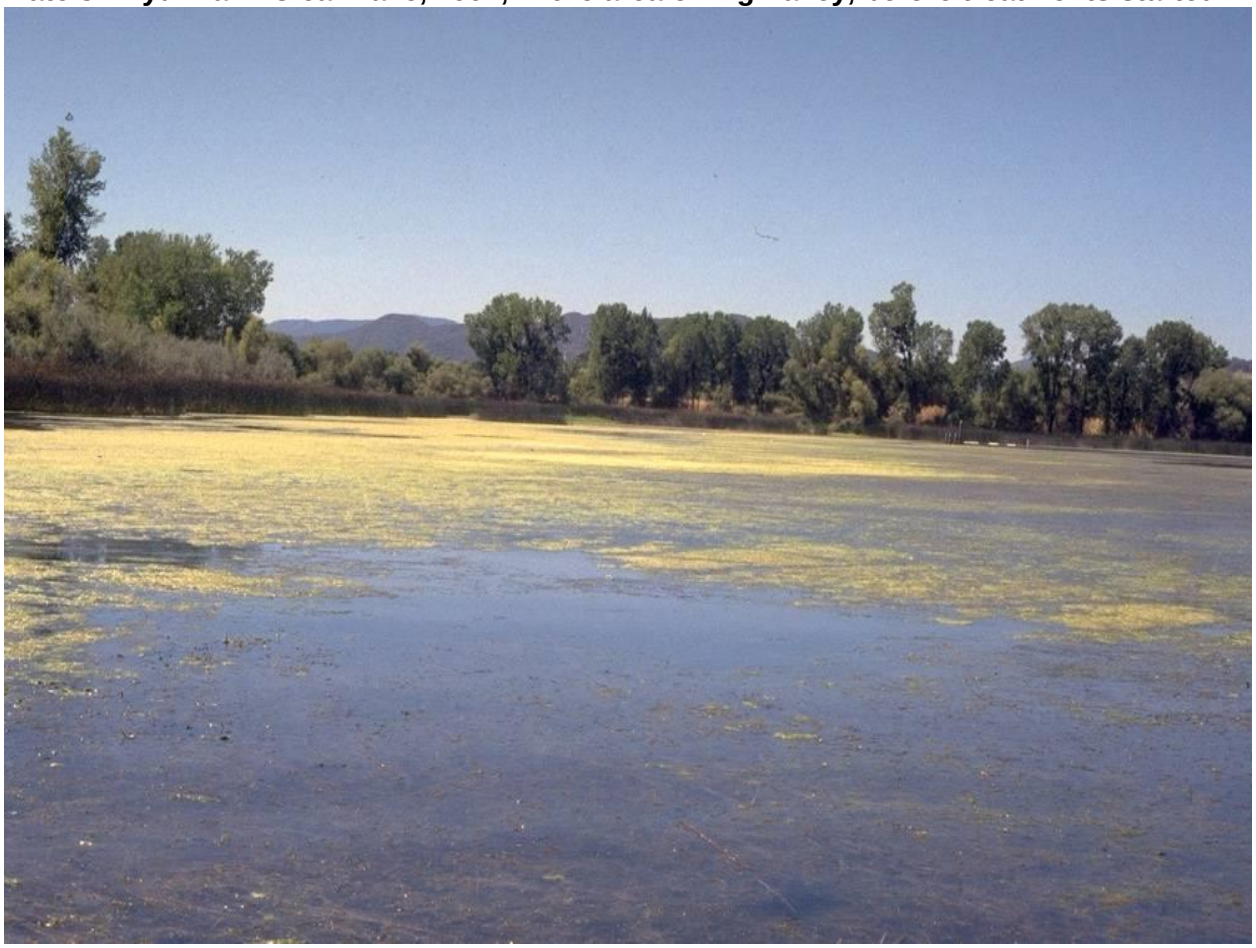
12) Significant changes occurred in the management at CDFA. Senior Scientist Pat Akers has been moved to the position of acting Branch Chief and has taken over the Beet Curly Top Virus and Pink Bollworm projects. The planning and management of the Hydrilla projects will transition to Senior Environmental Scientist David Kratville. Mr. Kratville spent 13 years working in the Noxious Weed Program (including 3 years as the statewide coordinator of the aquatic weed Purple Loosestrife Control project) and the last three years in the Vertebrate Pest Management Program at CDFA. During his tenure at CDFA he has continuously assisted the Hydrilla Eradication Program staff in the field.

## ACTIVE, ON-GOING SURVEY AND ERADICATION PROJECTS, IN DETAIL

### LAKE COUNTY *(Leads: Patrick Akers, David Kratville and Mike Meske)*

Hydrilla was first found in Clear Lake on August 1, 1994, during a routine detection survey by personnel from the CDFA and the Lake County Department of Agriculture (Plates 3, 5). The CDFA and Lake County biologists responded rapidly and applied copper herbicide to some infested areas within two weeks of the first detection. In addition, the CDFA and the Lake County Agricultural Commissioner put Lake County under quarantine[20]. The CDFA and Lake County biologists conducted the initial delimiting survey in 1994 and found that 175 to 200 surface acres along the shoreline of the upper arm of Clear Lake were infested (Plates 3, 5). Infestation levels varied from a few scattered plants to dense populations covering many acres. In addition, in both 1994 and 1995, thousands of hydrilla fragments were visible at some of the boat ramps at the western end of the lake. The CDFA convened a Scientific Advisory Panel in 1994 (Stocker, R.K. and L.W.J. Anderson *et. al.* 1994) which recommended a survey, treatment and public education program.

**Plate 3: Hydrilla in Clear Lake, 1994, in the area of Big Valley, before treatments started.**



[20] Because of the heavy recreational use of the lake, and the high risk that contaminated recreational equipment, clothing, or vehicles could spread hydrilla plant fragments, tubers, or turions around the Lake, or out of the Lake to nearby ponds, lakes, and streams (particularly Cache Creek), the CDFA and Lake County restricted movement of watercraft, motors, trailers, fishing gear, and other vehicles and equipment until they were inspected and cleaned of aquatic vegetation at the boat docks and ramps. These restrictions are still in place.

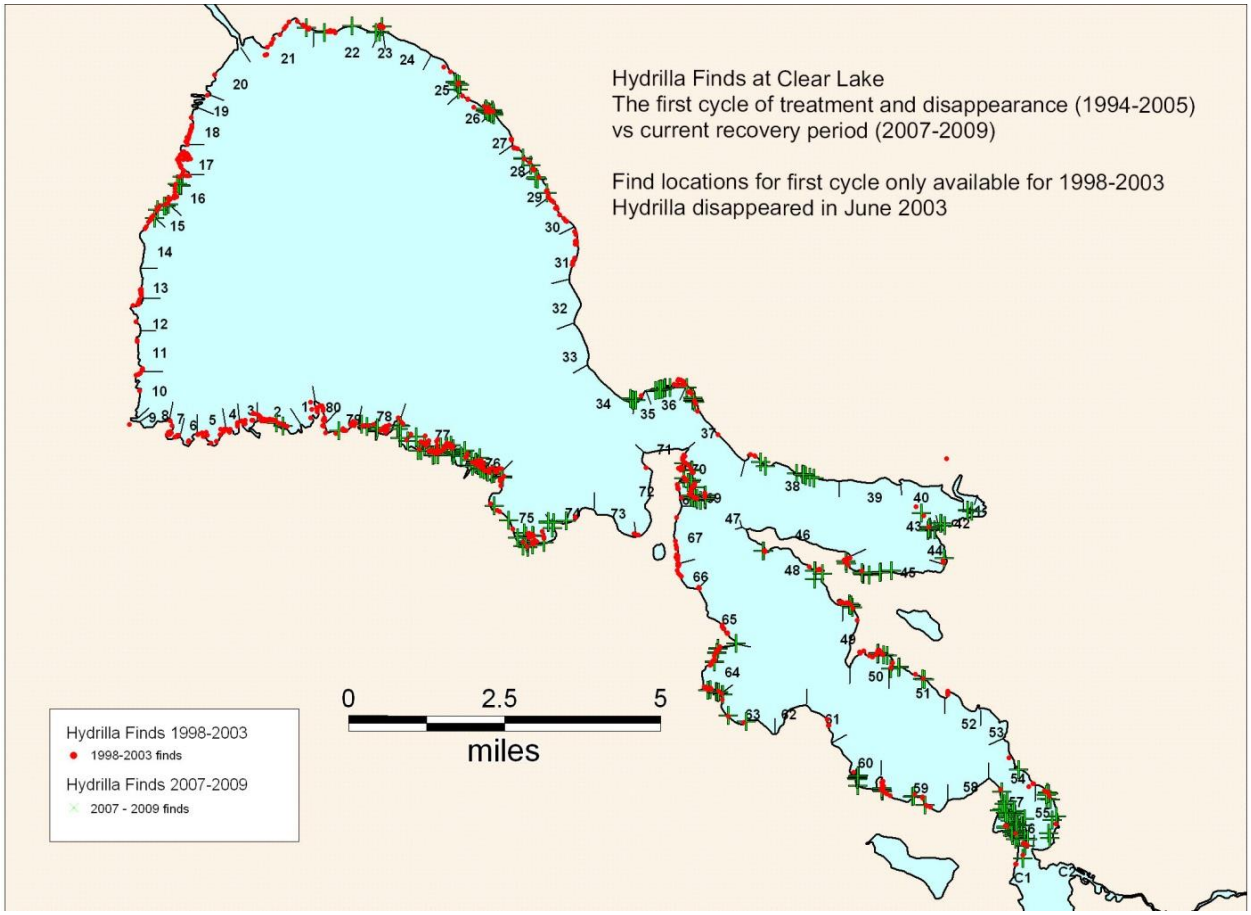
Clear Lake Project personnel divided the lake's shoreline into 85 (originally 80) management units in order to better organize eradication efforts (Plate 5). These management units were based upon landmarks for ease of navigation; they were not equal in length or area. The management units also varied in width but usually extended about 600 to 800 feet from shore toward the center of the lake where the water is 15 to 20 feet deep.

Hydrilla disappeared for the first time from Clear Lake on June 23, 2003, but plants returned in 2007. After plants disappeared in 2003, treatments had continued in 2003, 2004 and 2005. Surveys also continued without finding a single plant. The three seasons without plants met the then current criterion to end treatments, and no herbicides were applied in 2006. That was the first year since the beginning of the Clear Lake Project in 1994 that no herbicides were applied. No plants appeared in 2006, but they came back in 2007. With the return of the plants, treatments resumed. The plants made a very strong showing in 2008, but in 2009 the number of plant finds declined noticeably, as did the vigor of the plants. The number and vigor of plants continued to decline dramatically in 2010 and 2011. In 2012, the number of plants increased some, but they mostly occurred in three clusters, so total acreage did not increase much.

Program managers did not assume that the detection of no plants in Clear Lake in 2003 through 2006 meant that the lake was free of hydrilla. CDFA surveys are thorough, but no survey system can hope to detect a single small plant amongst the mass of aquatic weeds in a 43,000-acre lake. In addition, treatments with fluridone slow-release pellets continued through 2005. The purpose of this herbicide is to kill hydrilla plants as they emerge from underground tubers. If the herbicide performs as intended, it kills plants when they are small and very difficult to detect. Fluridone remains in the bottom sediments for an extended period, so it can mask a remnant infestation. Program biologists suspected that there were still tubers in Clear Lake that could continue to sprout. They increased the number of boat crews from two in 2006 to three in 2007 to intensify the survey at a time when the hydrilla might be recovering from earlier treatments. The number of crews was increased to four in 2008.

The 2007 resurgence of plants clearly came from tubers that were able to survive the three-year no-plant follow-up treatment after the first disappearance of the plants. A review of the history of plant finds around the lake through the entire project show that plants that appeared in 2007-2009 largely appeared where plants had been during the first elimination of the plants during 1994 through 2003 (Plate 4). Further, the 2007-09 plants appeared in many parts of the lake all at once. That is, the finds did not concentrate in one or a few locations. This was unlike the pattern of the original infestation, which was concentrated on the western shore of the lake (Plate 5). If the plants had been re-introduced to Clear Lake, it would likely have been at one or a few locations and not in widespread places all at the same time.

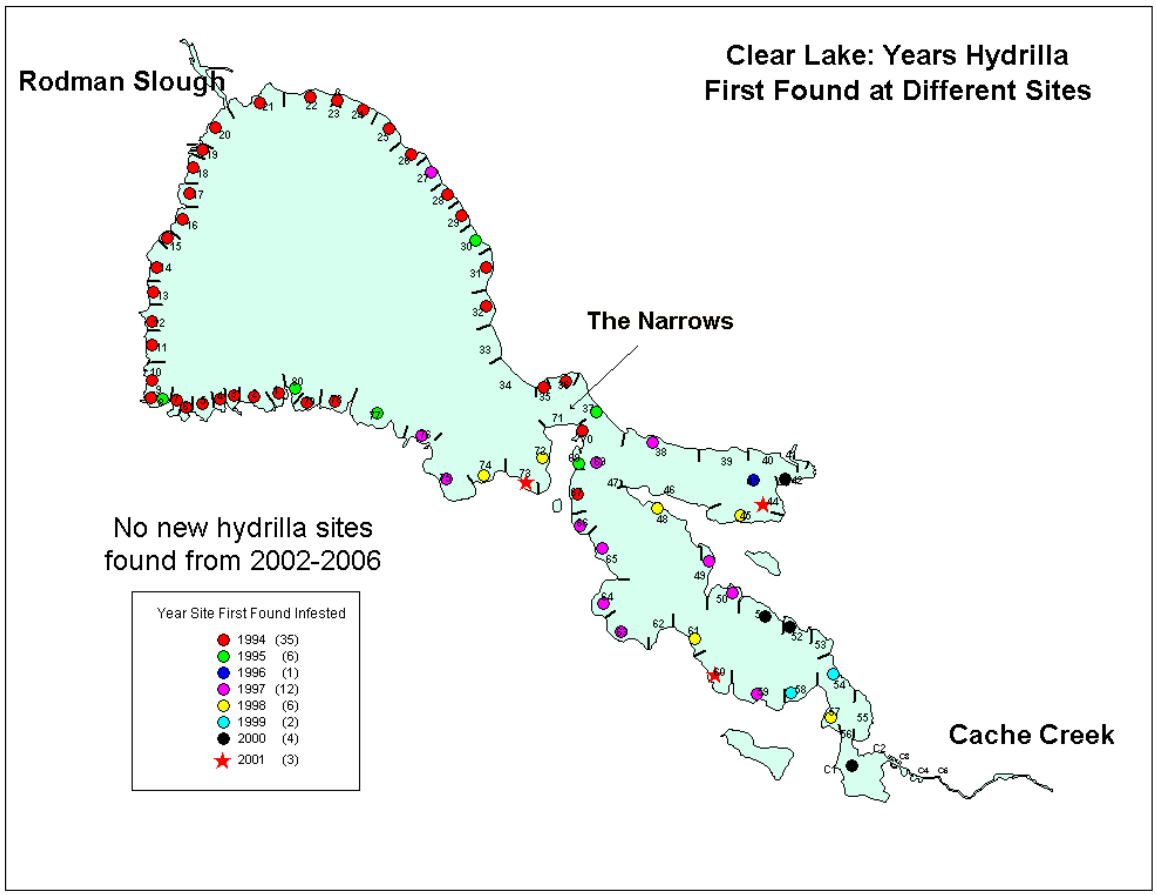
**Plate 4: Locations of plant finds from 2007-2009 compared to finds in 1996-2003**




The Clear Lake Project is a cooperative effort between the CDFA, the Lake County Department of Agriculture and the Lake County Department of Public Works. Clear Lake is the largest freshwater, natural lake completely within California's borders[21]. It is almost 22 miles long and eight miles wide, has a surface area of approximately 43,000 acres and has about 100 miles of shoreline. Clear Lake is located roughly 90 miles north of San Francisco. The lake is relatively shallow, with an average depth of approximately 26 feet. Because it is shallow and has winds most afternoons, Clear Lake's waters move and mix significantly even near the bottom, so it does not strongly develop the temperature-based layering (thermocline, stratification) that is typical of most lakes, not even in late summer. Water temperatures range from mid to high 30's degrees Celsius (86+ degrees Fahrenheit) in the summer and from 5 to 10 degrees Celsius (40 to 50 degrees Fahrenheit) in the winter. Temperatures are ideal for hydrilla germination and growth from April until mid-October, especially the monoecious form that is in Clear Lake.

[21] Clear Lake is a popular fishing and water sports recreational lake. Clear Lake has often been described as the "Bass Capital of the West." The Lake is host to a number of bass tournaments throughout the year. There are also catfish, crappie, hitch and bluegill in the lake. There is also carp bow hunting.

**Plate 5: Map of Clear Lake in Lake County Showing Location of Hydrilla Program Management Units and the Year Hydrilla First Detected in Each Unit.**




## Survey of Clear Lake

Surveying for hydrilla in Clear Lake is a challenge. Until 2011, surveys covered from the shoreline out to between 600 to 800 feet from the shore, so the area to be surveyed in one circuit of the lake's 100+ miles of shoreline was nominally about 7,300 acres (about 11 square miles). In addition, hydrilla is actually scarce in Clear Lake now. It takes a great deal of work to find the plants. For instance, the crews found 76 plants in 2009 but that represents a tiny area in a 43,000-acre lake. Square miles of Clear Lake's area are also heavily covered in submerged weeds, which interfere with surveys. Finding each plant took an estimated 95 to 105 person-hours of actual search time on the water in 2009.

The Project attempts to survey every management unit every three to four weeks during hydrilla's growing season. Surveys always represented at least 40 percent of the Clear Lake Project's activities, and that percentage continued to increase as management units reached the three-year criterion for ending treatments during 2002 to 2006. Presently survey represents about 85 percent of the crew's time, or around 8,000 person-hours per season of actual time on the water (not including prep and travel time).

### *Change in Survey Protocol*

The Technical Advisory Panel of 2009 (see below) recommended that the Clear Lake Project try to make its survey methods more systematic. They suggested exploring possibilities such as recording the boat tracks, analyzing search coverage, and/or setting up survey grids to direct each boat's search, all based on an on-board GIS. Unfortunately, the CDFA IT Division refused to allow the purchase of the GPS-enabled ruggedized field computers that would be necessary to carry out such work in the environment of an airboat. In an attempt to make the surveys at least a little more systematic, Clear Lake personnel re-drew the boundaries of the survey areas for 2011 and beyond (Plates 6, 7).

The new survey areas are all close to being equal in area. They are provided to the crews on a consumer-grade boating GPS, so they can track their progress. The old survey areas (= "management units") were never really drawn at all. They had somewhat vague boundaries along the shore that were based on not-necessarily-permanent landmarks, outer boundaries of "around" 600-800 feet, and surveys were not guided by GPS. The management units varied widely in length and in area, from about 35 acres to 409 acres, according to one attempt to draw the units (Plate 3). They totaled 8,460 acres by that same drawing. By contrast, the new survey areas are all very close to 78 acres. They were drawn using the following rules: survey from shore (Zero Rumsey) out a minimum of 100 feet and out to maximum of 1200 feet from shore or to a depth of 20 feet (Zero Rumsey), whichever comes first. This contour was plotted all around the lake excluding the outlet area where it enters Anderson Marsh, and then divided into 80 survey units, each intended to be equal in area. The new survey areas range from 77.4 to 78.9 acres, except for one, which was the last to be drawn at the end of drawing the 79 previous ones. There ended up being only 72 acres left to put into it. The total survey area within the lake is now 6,229 acres.

The new survey areas are short and broad where the water depth falls off very slowly, as in the western basin of the lake, and they are long and skinny where depth falls off quickly (Plate 7). However, they all have close to the same area, so it is more likely that the same intensity of survey effort will be put into each area than with the old areas. The boats each have a consumer-grade GPS with the survey areas marked in them, and the crews can see their tracks so they can see whether they are achieving even coverage.

**Plate 6: Comparison of old "management units" with new "survey areas"**

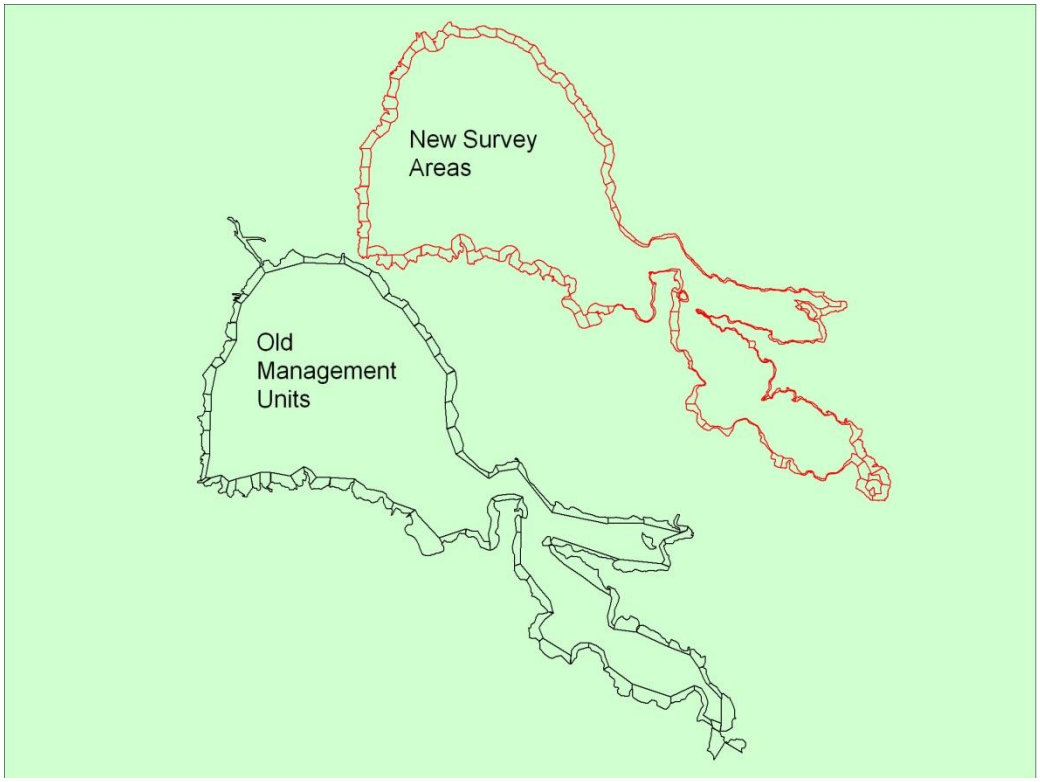
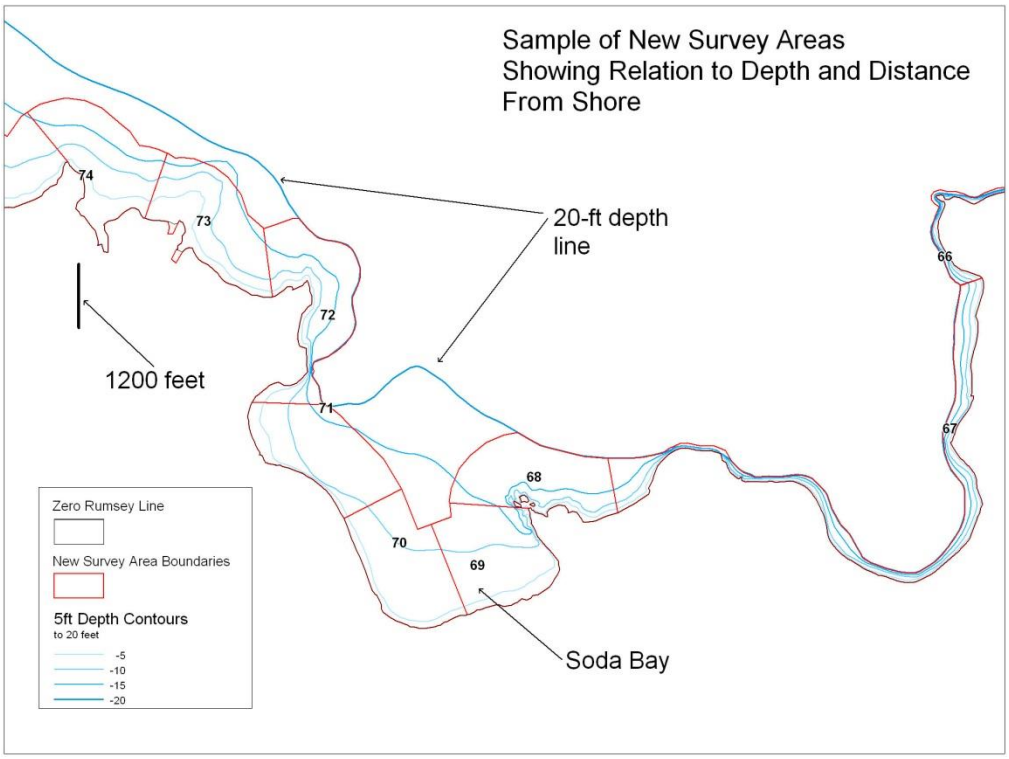



**Plate 7: Close-up of a few of the new equal-area survey areas, showing how their width and length depend on depth contours**



***Results***

In 2005, Clear Lake crews conducted 549 surveys of the management units for an average of 6.4 surveys per unit. In 2006, the crews surveyed the management units on average once every four weeks, conducting 495 surveys for an average of 5.9 surveys per unit. In 2007, even though hydrilla returned and treatments resumed, the crews surveyed 719 management units for an average of 8.5 visits to each unit. In 2008, the crews accomplished 744 surveys for an average of 8.75 visits to each unit, or about once every 3.4 weeks. In 2009, the crews accomplished 750 surveys for an average of 8.82 visits to each unit, or once every 2.9 weeks. In 2010, the Clear Lake leads decided to focus on spending some extra time during each survey bout in each management unit. In previous years, the crews tried to complete roughly three management units each day. In 2010, the goal was to survey roughly two units each day but put more time in each. This also decreased time moving between units. In 2010, the crews accomplished 566 surveys for an average of 6.9 visits to each management unit or about once every 3.4 weeks. In 2011, the crews performed 510 surveys of survey areas for an average of 6.0 surveys for each area, or an average of about once every 4.4 weeks. In 2012 the crews performed 520 surveys or about 6.0 surveys for each area. As the survey season ran from May 9 to November 13, this led to survey areas being surveyed on average once every 4.4 weeks, the same as 2011. In 2013 the crews performed 580 surveys or about 7.25 surveys for each area. As the survey season ran from May 6 to November 7, this led to survey areas being surveyed on average once every 3.6 weeks, more frequently than in 2011 and 2012.

No hydrilla plants were detected in 2004, 2005 or 2006, but they reappeared in 2007 (Table 2). Previously, the last plant found in the lake had been on June 23, 2003. In 2007, about 72 "spots" of hydrilla were found (Plate 9). In 2008, another 196 plant locations appeared. Most were single plants but many were large, vigorous clumps up to several yards across and topping out at the water's surface, especially during September and October. In 2009, counts were down with about 76 plant locations and the plants were, in general, much less vigorous than in 2008. Only a couple plants reached the surface and none were larger than a yard or two in diameter. Most finds were just a few weak stems. In 2010 the decline was even more marked. The crews found only 12 hydrilla plants and most were very sickly. Only five finds were outside established treatment areas, which meant only 20 acres were newly brought under treatment that year. In 2011 only 6 plants were found, all small and mostly sickly.

**Table 2: Level of Hydrilla Infestation in Clear Lake, Lake County by Number of Infested Management Units* and Number of Finds, 2000 to 2012**

| Year | Number of Management Units with "Finds" | Number of Hydrilla "Finds" |
|---|---|---|
| 2000 | 31 | 67 |
| 2001 | 21 | 41 |
| 2002 | 6 | 12 |
| 2003 | 1 | 1 |
| 2004-6 | 0 | 0 |
| 2007 | 24 | 72 |
| 2008 | 34 | 196 |
| 2009 | 24 | 76 |
| 2010 | 7 | 12 |
| 2011 | 5 | 6 |
| 2012 | 5 | 26 |
| 2013 | 6 | 6 |

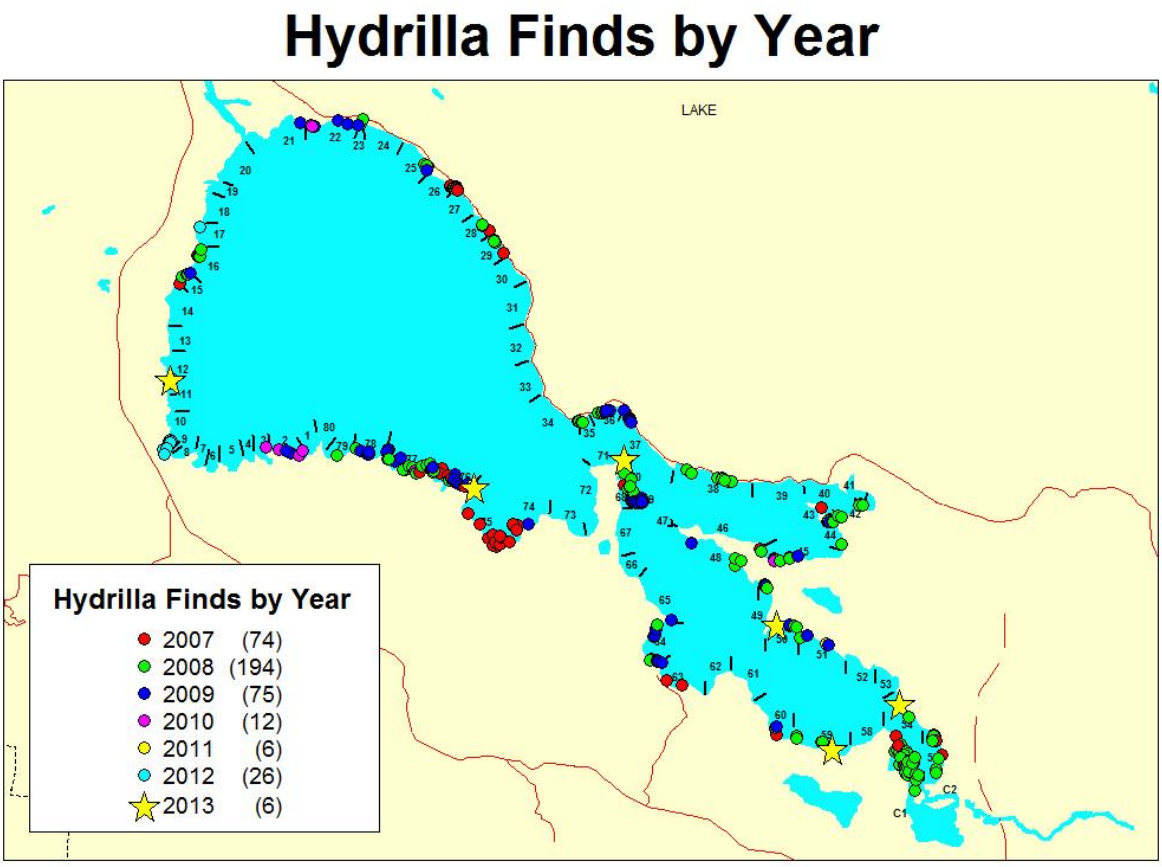
*The management units were originally defined with reference to natural landmarks for ease of location, survey, and treatment. Management units are not identical in size or shape.

In 2013, six individual plants were found, down from 26 finds in 2012. These single plant finds were scattered around the lake, following the typical pattern seen in years past, except in 2012. In that year, most of the plants occurred in three clusters, all of which were within roughly 250 feet of each other. Out of the six finds in 2013, two required creation of new treatment areas, and one that was added back the same year it was removed, for a total of additional 10 acres under treatment. The other three finds were in existing treatment areas.

The first plant in 2013 was found on June 24 (July 9, June 17, June 9, June 15, August 10 and July 16 in 2007 through 2012, respectively) in Unit 11, on the west shore in the western basin, off Lakeport. The last find was on October 29 (November 15, December 9, November 12, August 19, November 7 and September 13 in 2007 through 2012), in Unit 71 of the Narrows. The first survey in 2013 was on May 6 and the last on November 7. The water temperature at the time of the first survey was 20 degrees Celsius (68 degrees Fahrenheit) and was 14.4 degrees Celsius (58 degrees Fahrenheit) at the last survey.

Other aquatic plant species detected in Clear Lake in 2013 included coontail, curlyleaf pondweed, American pondweed (*P. nodosus*), Illinois pondweed (*P. illinoensis*), egeria, common elodea, Eurasian watermilfoil (*Myriophyllum spicatum*), western watermilfoil (*M. hippuroides),* sago pondweed (*Stuckenia filiformis*), smartweed (*Polygonum* species), coontail, water primrose, spatterdock (*Nuphar luteum*) and spiny and southern naiad.

**Plate 8: Hydrilla Finds 2007-2013**




Clear Lake crews survey the deeper center sections of the lake in mid to late summer every year. This period was chosen because any hydrilla plants growing in the deeper sections of the lake would have reached the water surface by this time and would be fairly easy to detect. In 2013, project crews made two center section surveys. No hydrilla has ever been detected in deep-water sections of the lake.

In addition to surveys, the Clear Lake hydrilla crew conducts boat and trailer inspections for hydrilla before and after major fishing and boating events. In 2013 they conducted 176 boat and trailer inspections. No hydrilla was found.

**Treatments of Clear Lake**

Herbicide use in Clear Lake had dropped during 2002 through 2006, but that trend reversed itself in 2007 (Table 3) with the return of plants.

**Table 3: Aquatic Herbicide Used by the CDFA in Clear Lake, Lake County 2000 – 2013**

| year | Copper, pounds of active ingredient | Fluridone, pounds of active ingredient |
|---|---|---|
| 2000 | 1,960 | 2,689 |
| 2001 | 1,112 | 2,839 |
| 2002 | 282 | 2,370 |
| 2003 | 12 | 1,824 |
| 2004 | 0 | 867 |
| 2005 | 0 | 219 |
| 2006 | 0 | 8.2 |
| 2007 | 4,352 | 570 |
| 2008 | 5,295 | 912 |
| 2009 | 2,206 | 1,140 |
| 2010 | 492 | 1,457 |
| 2011 | 285 | 1,464 |
| 2012 | 369 | 1,266 |
| **2013** | **398** | **1,090** |

The Project used 538 pounds of elemental copper in 2013. Each find in a new area receives a single initial treatment with copper at 1 ppm. The treatment is very effective at burning back any hydrilla present and it greatly reduces the amount of biomass that might otherwise tie up fluridone. Fluridone is used for the remainder of all treatments.

In 2013 fluridone use was reduced to only 1,090 pounds of active ingredient applied. Ten acres were brought back in to treatment in 2013 while 91 acres were removed from treatment.

A new formulation of fluridone pellet was utilized for the first time in 2013. The new product named Sonar H4C consists of a lower concentration (2.7% vs. 5%) of fluridone per pellet than the standard Sonar Slow-Release Pellets (SRP) the program has traditionally used. In addition, the overall pellet size has been reduced to nearly half the size of SRP pellets. The result is nearly four times the number of pellets dispensed to reach the same quantity of active ingredient applied. The goal of the new formulation is to increase the number of pesticide emitting pellets covering the bottom of the treatment area. This should increase the likelihood of a pellet being in close proximity to an emerging hydrilla plant, reducing the chance of a plant growing in an area with low concentrations of fluridone. The new product was used in nine treatment areas totaling 71 acres in size.

The new criteria for taking areas out of treatment will depend not just on their time under treatment with no plants, but on other factors that, at least qualitatively, consider the relative likelihood of plants returning and the danger posed by any such return. The additional criteria include such things as water depth and general weediness (which affect survey effectiveness), number of plant finds that were in the treatment area or areas nearby (which may indicate likelihood of plants returning), length of time in treatment before plants disappeared, and location in the lake (which may indicate dangers due to water movement or routes of escaping the lake). For areas that appear relatively safe (such as areas that only had a single isolated

plant), four years of treatment with no plants may be deemed adequate. Five years will probably be the accepted criteria for most areas. However, for a few high-risk areas, such as near the lake's outlet or major boat ramps, or perhaps in areas that have had a long history of plant finds nearby, even six years of treatment may be deemed prudent. The fact is, we don't know just how long tubers will survive. We know three years of treatment without plants wasn't enough, but we also know from 2011's tuber survey that tubers appear to be becoming rare in the lake. We have good reason to hope that we are pushing the general population toward extinction, but we have to acknowledge that taking an area out of treatment is merely a requirement to check whether eradication has been reached. It is the follow-up surveys that determine eradication status, and they may instead show that more treatment is necessary.

**Table 4: Changes in area under treatment through time in the Clear Lake Hydrilla Project**

| Season | Acres at start of season | Acres brought into treatment | Acres in treatment, end of season | Acres removed from treatment, between seasons |
|---|---|---|---|---|
| 2007 | 0 | 248 | 248 | 0 |
| 2008 | 248 | 325 | 573 | 0 |
| 2009 | 599* | 120 | 719 | 0 |
| 2010 | 719 | 20 | 739 | 0 |
| 2011 | 739 | 9.6 | 748.6 | 89.7 |
| 2012 | 658.9 | 31 | 689.9 | 86.6 |
| 2013 | 603.3 | 10.3 | 613.6 | TBD |

* = start of 2009 is higher than end of 2008 because of merging and adjustment of treatment areas between seasons

Clear Lake is a weedy lake and the Lake County Department of Public Works has an ongoing program for the management of general aquatic weeds. They contract with private applicators to control nuisance weeds in high-use areas, and they issue permits for private groups to control weeds in the lake. These permits require the permittee to identify the location of all proposed treatments, the method of treatment and any aquatic vegetation present. The CDFA lead person at Clear Lake approves these permits before treatment can commence. In 2013, there were 73 permits for treatments.

### Surveys Outside of the Quarantine Zone

With the intensive treatments and survey on the lake itself, surveys of other water bodies in the area have dropped off. In 2013, no water bodies other than Clear Lake were surveyed.

### Public Information and Awareness

Public information and awareness are essential components of the Clear Lake Project. Since public access to the lake is not restricted and there are hundreds of access points, fishermen, guides, outfitters, fishing tournament organizers, boaters and other users of Clear Lake, the public needs to know how to prevent the spread of hydrilla within the lake or from Clear Lake to other lakes and streams. Clear Lake Project personnel distributed approximately 800 informational pamphlets to businesses and government agencies around Clear Lake.

In 2013, Clear Lake Hydrilla Eradication Project personnel made several presentations about the project. The project was highlighted in a presentation at the Western Aquatic Plant Management Society Conference in April. Patrick Akers gave a presentation to the UC Davis Aquatic Weed School in September. David Kratville gave aquatic weed ID and control presentations at three different pesticide applicator continuing education meetings.

**Technical Advisory Panel Initiatives**

In October 2009, the Program convened a Technical Advisory Panel (TAP) of four outside experts to review the Clear Lake Project and recommend improvements. The group spent a day and a half discussing the project. They suggested a number of refinements for both survey and treatment, but supported the overall goal of eradication and the general approach. Their report is available on the CDFA's Hydrilla Program web page at: http://www.cdfa.ca.gov/phpps/ipc/hydrilla/hydrilla_hp.htm.

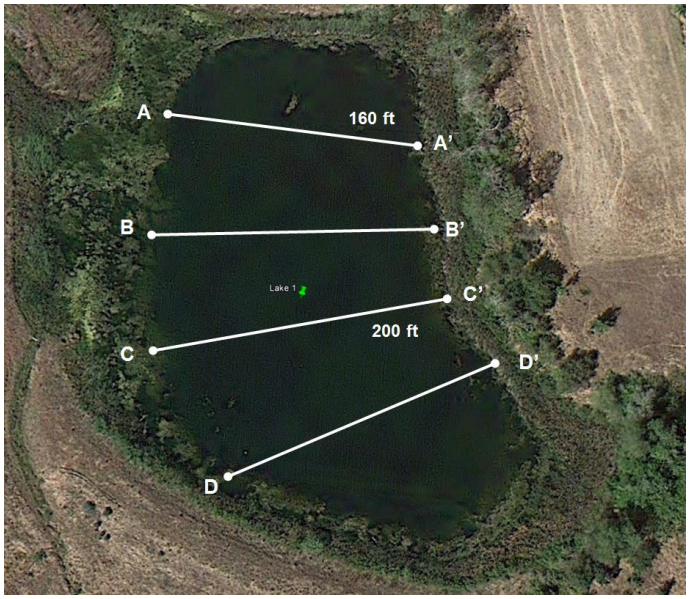
Several of their suggestions have been carried out and reported in earlier reports, including re-drawing the survey boundaries, a tuber survey, and "artificial hydrilla target" survey hooking tests, a dredging trial and a small study of the effects of years in treatment on fluridone sediment concentrations. The new survey boundaries are now in everyday use and the survey hooking tests still continue when time permits.

In 2013, the Project participated in an evaluation of an alternate herbicide:

**Endothall Aquatic Herbicide Evaluation**

CDFA worked with Joe DiTomaso and Guy Kyser (University of California, Davis) and with Joe Vassios (United Phosphorus, Inc.) to treat and evaluate a pond infested with hydrilla. UPI markets an aquatic herbicide, Aquathol (active ingredient endothall), which controls submerged aquatic plants including hydrilla. According to UPI, this formulation does not affect algae, emergent / shoreline plants, or animals (including fish).

The pond is located near Oregon House, Yuba County, at 39°20'N, 121°15'W, 553 m elevation. It is enclosed by a berm on the downhill side and appears to be fed by rainwater, with no regular in- or outflow. At the time of sampling and treatment, the pond had a surface area of about 2 acres and a maximum depth of 6 to 7 m.



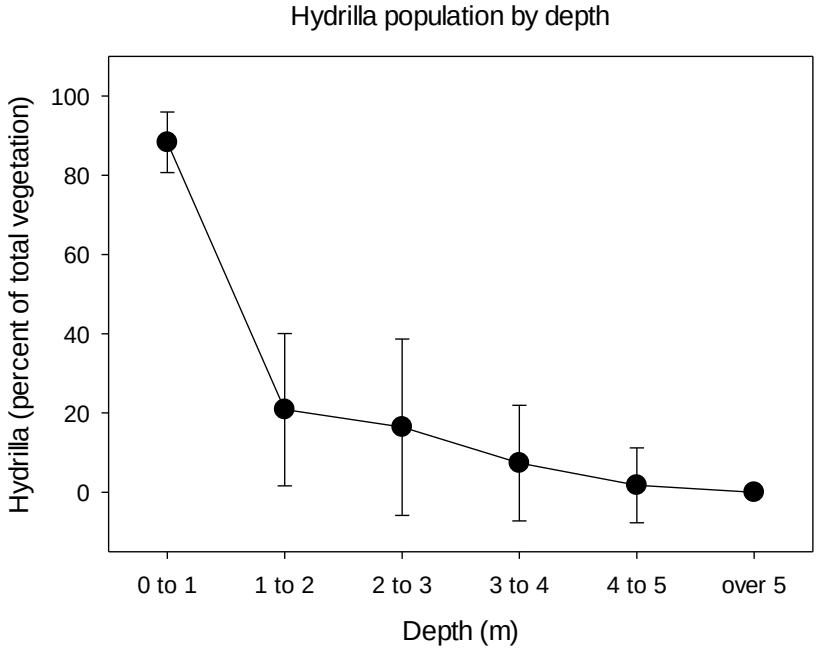

Initial sampling was performed 18 July 2013. Posts were set up at 8 locations around the pond, and floating polypropylene rope was run across the pond as in the accompanying figure. The rope was marked at 2-m intervals. Surveyors ran transects across the pond, using a two-sided aquatic plant sampling rake on a 4-m pole to draw up plant samples at each 2-m interval. Sampling depths were recorded and samples were bagged for analysis.

In all, 129 points were sampled. Although the sampling pole was not long enough

to reach a few points in the center, we found very little hydrilla in samples from deeper than 4 m. In addition, sonar readings confirmed that vegetation was sparse in places deeper than 5 m.

We sorted the samples to determine the percentage of hydrilla and other vegetation at each sampling point. The majority of submerged vegetation was coontail (*Ceratophyllum demersum*), particularly at greater depths. Eurasian watermilfoil (*Myriophyllum spicatum*) was present in some parts of the pond, usually at depths between 1 and 2 m. Hydrilla made up a large part of the vegetation in samples from depths less than 1.5 m (Table 5). Over the complete sample set, hydrilla comprised ~11% of the vegetation cover, coontail 82%, and watermilfoil 7%.

Table 5: Hydrilla Population




Following completion of the initial sampling, the pond was treated with Aquathol on the same day.

We returned 20 September, two months after treatment, to evaluate treatment effects. We resampled all points using the same procedure. Coontail and watermilfoil were not present in any samples. A small sample of live hydrilla was found in one sample, at a depth of 1.8 m.

The site will be reevaluated in 2014.

**NEVADA COUNTY *(Lead: Jonathan Heintz)***

**Overview of Projects**

Hydrilla was found in a pond in a waste transfer station in July 2004 in Nevada County. In 2005, probably as a result of heightened awareness, two more infestations were found in the county. One infestation was found at the County Fairgrounds in late February 2005, and a second was found in late December in a small irrigation pond about six miles south of Grass Valley. For clarity, the infestations will be treated separately.

**Waste Transfer Station Fire Control Pond**

Many details concerning the infestation and initiation of the eradication project were presented in the 2004 report and only a summary is provided here.

On July 21, 2004, a representative of an aquatic plant management company found hydrilla in a fire control pond at the Nevada County Transfer Facility near Grass Valley. The CDFA and the Nevada County Department of Agriculture then started the Nevada County Hydrilla Project.

Project biologists mapped the pond (Plate 16) within two weeks. The pond is 0.6 acres in area, averages 18 feet deep and has a rubber liner. It provides water for fire emergencies and to cool a wood waste chipping operation. The chipping operation requires substantial amounts of water several times a month. The Transfer Facility site itself is a 'no-runoff' site and is surrounded by a drainage canal and several ponds to capture runoff.

Several hydrilla mats were clearly visible in the northeastern third of the pond, including one that was fairly large. In early August 2004, CDFA divers free-dived the pond at the northeast end where the hydrilla mats were most visible. Divers reported several inches of sediment at this end of the pond and recovered several tubers. Dr. Lars Anderson of the USDA-Agricultural Research Service also did a pre-treatment survey of the density of the hydrilla infestation finding an average of 2.3 ± 0.7 kilograms of hydrilla (dry weight) per square meter. The survey also showed that most of the water column was filled with hydrilla, even where it was not clearly visible at the surface.

**Survey and Treatment of the Fire Control Pond**

As 2011 was the sixth year without a hydrilla find while still under treatment (Table 6) , treatments were suspended in 2012 to determine whether the population had been fully eradicated. The Project Biologist surveyed the pond thoroughly once in July 2012 and once at the end of the season in 2013. No hydrilla was found.

**Nevada County Fairgrounds Pond**

On February 22, 2005, a county biologist on a mosquito survey saw plants that he suspected might be hydrilla in the main pond at the County Fairgrounds. He reported to the County Agricultural Commissioner's Office and the plant was confirmed as hydrilla by the CDFA Botany Lab. On February 24, CDFA biologists conducted their first assessment of the pond. Raking and visual surveys indicated that the pond was nearly 70 percent covered with hydrilla. Surveys of the ponds and streams in the area found no other hydrilla locations.

The major function of the pond is irrigation for the fairgrounds, but it is also a popular local fishing spot, locally known as Lions Lake because the Lions Club holds an annual fishing derby there. GPS measurements showed that the area of the pond is 2.75 acres, and boat transects showed that the average depth is about 5.5 feet. Most of its water comes from the Nevada Irrigation District flume, which runs through the Fairgrounds near the pond, but during rainstorms the pond can receive considerable runoff. The pond was formed by a dam or berm and is not directly in the bed of the local stream system, which leads to Squirrel Creek and the Yuba River. During dry weather, little or no water leaves the pond, but during storms significant amounts can overflow into the local stream. Reference sources indicated that there was Scadden Flat checkermallow (*Sidalcea stipularis),* an endangered plant, in the vicinity. A survey for the plant was conducted and project personnel found two populations. One population lies

uphill of the pond area and away from any influence from it, but the other population lies about half a mile downstream from the pond. The plants do not reside directly in the stream but do grow in the riparian area nearby. Because of the presence of the checkermallow and the use of the pond water for irrigation, project personnel limit the application rate of fluridone in the pond to 20 ppb at any time. In past practice, this level has proved to not be toxic, even to sensitive species of plants, while still controlling the hydrilla.

**Survey and Treatment of the Fairgrounds Pond**

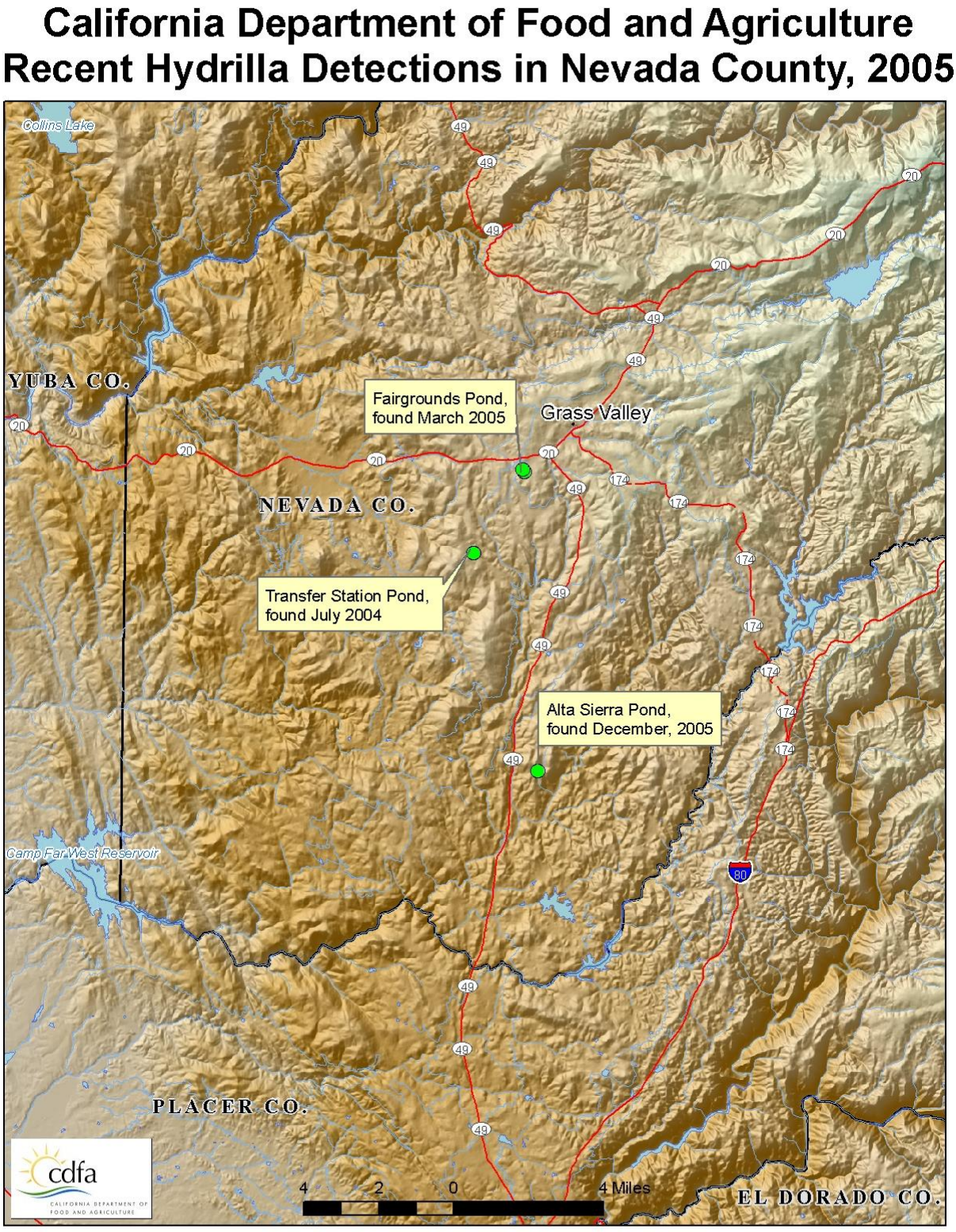
The fairgrounds pond has now gone six years without a hydrilla find (Table 6). Treatments were suspended in 2012 to determine whether the population has been fully eradicated.
The site was visited three times in 2013 and no hydrilla plants were found. The pond will be surveyed at least two more years before considering whether eradication has been reached.

**Valkenburg Lane Pond**

On December 21, 2005, an employee of the Nevada County Irrigation District, who had attended a training session on hydrilla, was checking a section of the Nevada County Irrigation canal for another purpose when he noted suspicious plants in a small irrigation/recreational pond just downhill from the canal. He informed the Nevada County Agricultural Commissioner's Office and Brian Steger from the office took a sample and sent it to the CDFA Botany Laboratory. The lab verified the plant as hydrilla, probably dioecious, on December 23. The pond is within the town limits of Alta Sierra, off Lime Kiln Road, about six miles south of Grass Valley. It is about 0.1 acres in area and 5 to 10 feet deep. The pond is formed by a small berm and does not have any significant connection to the local stream system. Its situation also limits local runoff into the pond and any potential overflow.

A group of biologists from the Commissioner's Office and the CDFA Hydrilla Program visited the pond before the end of the year and found it approximately 95 percent covered with hydrilla. On January 20, 2006, a crew from the Hydrilla Program surveyed all the ponds between the Valkenburg Pond and Wolf Creek and also surveyed the irrigation canal for several hundred yards both upstream and downstream of the pond. They found no other infested water bodies. The crew set up cage screens on the outflow pipe.

**Plate 9: Map of Ponds currently known to be infested in Nevada County**



**Surveys and Treatments of Valkenburg Pond**

The treatments of 2006 and 2007 brought the hydrilla populations down to where no plants were visible in the pond by early 2007. Treatments continued through 2011. The Project biologist surveyed the pond four times in 2012 at monthly intervals, beginning in June. He found hydrilla during the visit in mid-July, with three small, well-separated plants. Prior to this find, the pond had been free of hydrilla for five years, discounting one unverified suspect in 2010. We had started the season intending to suspend the treatments this year, but after the find, the pond was again treated to 30 ppb late in the season. No plants were found in 2013. One treatment of fluridone at 30 ppb was made at the beginning of the season.

**Table 6: Hydrilla finds in Nevada County ponds by year**

| | | | Year | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Pond** | **2006** | **2007** | **2008** | **2009** | **2010** | **2011** | **2012** | **2013** |
| Transfer | N | N | N | N | N | N | N | N |
| Fairgrounds | Y (3 plants) | N | N | N | N | N | N | N |
| Valkenburg | Y (15% cover) | N | N | N | 1?* | N | Y | N |

* = suspicious plant spotted on visual survey but could not be recovered to confirm

**SHASTA COUNTY *(Leads: Jonathan Heintz, David Kratville)***

The Shasta County Hydrilla Eradication Project (Shasta Project) is a cooperative effort between the CDFA and the Shasta County Agricultural Commissioner. The Shasta Project began in 1985 after the dioecious form of hydrilla was detected in ponds located next to the Sacramento River. Initial efforts resulted in the eradication of hydrilla found in all 11 of the originally infested ponds by the year 2000.

However, two new infestations occurred in 1994 and 1996. These infestations appear to be unrelated to the previous ones. In 1994, a new infestation was detected in two interconnected ponds in River Park in Anderson, about eight miles south of Redding. In 1996 a separate hydrilla infestation was detected in a pond system at the Riverview Golf Course in Redding (Plate 17). The Shasta Project initiated a treatment program of aquatic herbicides and manual removal.

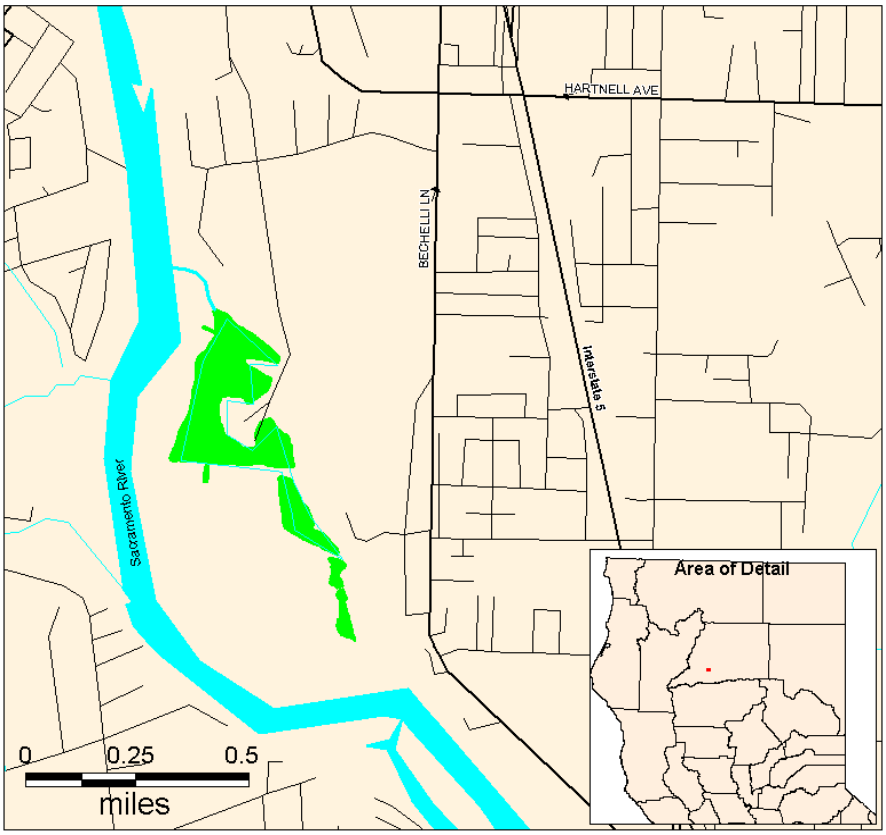
**Survey and Treatment in the Anderson River Park Ponds**

The Shasta Project crew did not detect hydrilla in the two Anderson River Park Ponds from 1999 to 2004, but in 2005 hydrilla returned to one of the ponds. The re-appearance of plants re-initiated the complete eradication cycle. The hydrilla crew surveyed the ponds 17 times in 2006, and plants continued to emerge. The first survey was on May 31 and the last was on November 15. The first finds were five plants on May 31. The crew found two more plants in June, 11 plants in July, 12 in the first two weeks of August, and over 100 plants on August 22. The last find, a single plant, was on September 8. In total, approximately 130 plants appeared in 2006. The crews treated the infested pond in 2006 with hand digging, dredging and

herbicides. Between June 2 and August 11, the crews dug and dredged a total of 26 plants. The Program delayed fluridone treatments in 2006 to give the plants an opportunity to appear because fluridone lasts several months and will mask infestations. The first treatment occurred on August 25, just after the plants made their major flush. Four treatments were made at two-week intervals with fluridone slow release pellets. The first treatment was at 50 ppb, and the remaining three were each at 30 ppb, giving a total rate of 140 ppb. On August 23, 2006, prior to the first fluridone treatment, the crew treated the part of the pond that had plants with copper ethylenediamine complex (Komeen), at 1 ppm. This treatment removes the top growth of all aquatic vegetation, which allows more fluridone to remain and attack newly emerging hydrilla. No hydrilla appeared in the Anderson Ponds from 2007 on. The crews surveyed the ponds 13 times in 2007, nine times in 2008, three times in 2009, twice in 2010, and two times in 2011.

By the end of 2011, the Anderson Park ponds had gone five years in treatment with no plants (2007-11). No treatments were made in 2012. Starting in 2012, the ponds are now intensively surveyed twice each year. For each survey, four to seven people have been involved, coming from the Sacramento, Fresno, and Clear Lake offices. Surveys are conducted in two-person canoes or one-person kayaks and a full day is spent surveying the 13 acres covered by the ponds. The surveys are also timed to match the best opportunities for finding the hydrilla. The first was in early July, when the hydrilla is entering its phase of maximal growth rate. The second was in the first week of September, when hydrilla plants should be reaching their maximum size. No hydrilla was found in either 2012 or 2013.

**Plate 10: Map of Infestation at Riverview Golf Course, Redding.**



**Survey and Treatment of Riverview Golf Course Ponds**

The Riverview Golf Course infestation consists of four interconnected ponds (Plate 17). The pond farthest upstream is approximately 30 acres in size and is adjacent to but outside the golf course. Project personnel refer to it as "Rother's Pond." It is fed by a small canal from the Sacramento River. The next three ponds are on the golf course, and, heading downstream, are approximately six, two and one acres in area. Water returns to the Sacramento River by a small stream from the one-acre pond. The one-acre pond and return stream often go partially or completely dry in the late summer. When Shasta Project crews first surveyed these ponds in 1996, they found the 30-acre pond to be infested in the lower 15 acres, where the infestation ranged from scattered single plants to small clumps. The six-acre pond was moderately to heavily infested, and the two small ponds were heavily infested.

The crew found 12 plants in 2005 in Rother's Pond and three in 2006, but there were no plants in 2007, 2008, 2009 or 2010 (Table 7). There were 11 surveys of Rother's Pond in 2009. In 2010, the crew inspected Rother's Pond 10 times and twice in 2011.

The crew surveyed the ponds twice in 2013. The surveys this year were intense, spending a full day surveying the 39 acres covered by the ponds. As in Anderson Pond, for each survey, four to seven people were involved, coming from the Sacramento, Fresno, and Clear Lake offices. The surveys were also timed to match the best opportunities for finding the hydrilla. The first was in early July and the second was in the first week of September. No hydrilla was found in either survey. No plants have been found in the lower three ponds since 2002.

As of 2011, the golf course ponds had gone five years under treatment with no plants. The Project leads decided to not treat in 2012 and 2013, contining the follow-up confirmation phase of surveys started in 2012.

**Table 7: Number of Hydrilla Plants and Tubers Found and Removed from Redding Golf Course Ponds, Shasta County 2000 - 2013**

| | YEAR | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007-2012 | 2013 |
|---|---|---|---|---|---|---|---|---|---|---|
| Rother's Pond | Plants | 1 | 9 | 18* | 1 | 0 | 12 | 3 | 0 | 0 |
| | Tubers | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Riverview Golf Course Ponds 1, 2, 3 | Plants | 32* | 31 | 10 | 0 | 0 | 0 | 0 | 0 | 0 |
| | Tubers | 0 | 0 | 75** | 0 | 0 | 0 | 0 | 0 | 0 |

*Estimated from narrative descriptions.
**Dredging operation in 2002 in main infested area; no dredging done in other years.

**Survey Inside and Outside the Quarantine Zone**[22]

Because of budget constraints, 200 to 300 ponds and stream sites that were previously checked each year are no longer being surveyed. No general detection surveys have been done since 2009.

## YUBA COUNTY *(Lead: Jonathan Heintz)*

Yuba County has had three distinct hydrilla infestations: Lake Ellis, Shakey's Pond and Oregon House. The first two infestations were considered eradicated, but the infestation in Shakey's Pond reappeared in 2007. The first hydrilla infestation ever found in California was in Lake Ellis, a 31-acre ornamental lake in the center of Marysville. Dioecious hydrilla was found there in 1976. In 1979, Program personnel drew down the lake, removed the hydrosoil and treated the infested areas with metam-sodium (Vapam). Six plants re-appeared in 1980 in one small location. The biologists then treated the entire lake with endothall and copper ethylenediamine complex, with special attention paid to the infested location. By 1981, the lake was free of hydrilla and eradication was declared in 1984. A second infestation in Yuba County was discovered in 1990 in Shakey's Pond. Hand removal and aquatic herbicide treatments reduced the number of plants in the pond until only one plant was found in 1996, when the pond received three treatments of fluridone. No plants were found in the pond after 1996, and this infestation was also considered eradicated after 2002. That status continued until 2007, when a follow-up inspection found hydrilla in the pond. More details will follow the discussion of the Oregon House infestation.

### Oregon House: The On-Going Eradication Project

On August 7, 1997, a third infestation of hydrilla appeared in Yuba County near Oregon House (Plate 19), about halfway between Marysville and Grass Valley, north of Highway 20. A visitor to a local winery suspected that hydrilla was in one of the ponds on the grounds and reported it to the Yuba County Agricultural Commissioner's Office. Yuba County biologists investigated, found hydrilla and sent a sample to the CDFA Plant Pest Diagnostics Lab for confirmation. Scientists at the United States Department of Agriculture, Agricultural Research Service (USDA-ARS) Exotic and Invasive Weed Unit confirmed it to be the monoecious type, different from the infestations in Lake Ellis and Shakey's Pond.

The Oregon House Hydrilla Eradication Project (Oregon House Project) started after this first detection. The Project is a cooperative effort between the CDFA and the Yuba County Agricultural Commissioner. Biologists conducted delimitation surveys at the winery and found a total of five infested ponds (ranging from 0.15 to 3.0 acres in size and nine to 13 feet deep) and an infested ornamental fountain[23] (Plate 21). The winery uses two of the ponds, Ditch Pond and Tank Pond, to irrigate their vineyard. Project crews also conducted delimitation surveys within a three-mile quarantine zone and detected additional infestations on three private properties: the Spiers 1, 2, and 3 Ponds (3.8, 0.5, 0.4 acres) and the Clouse and Ronen Ponds (1.9 and 0.1 acres) (Plate 21). The two smaller Spiers Ponds were used for rearing catfish. Another 40 ponds were surveyed and found not to be infested.

[22] Hydrilla infested counties are "Eradication areas" by California Code of Regulations, Section 3962. "Quarantine zones" are reduced areas within "Eradication areas" and are the specific water bodies in the county where there are restrictions as to water access or use, as per California Code of Regulations, Section 3410.

[23] The infested water lilies in the ornamental fountain were removed, the hydrilla plants and tubers destroyed, and the water lilies repotted and returned.

In 2000, project survey crews on routine surveys detected three additional infested ponds. These were Reservoir 23 (0.25 surface acres), Davis (0.37 acres) and Citron (0.22 acres) Ponds (Plate 21). Reservoir 23 is also used for irrigation at the winery. In 2003, surveys detected a single hydrilla plant in Spiers Pond number 5. Project staff had surveyed this pond multiple times per year since the beginning of the project. A plant fragment possibly floated down to it from Spiers Pond number 1, via a small creek. In 2007, a Project biologist discovered a new pond (named Cornejo) in the area that had been dug recently. It proved to be infested. In 2012, a newly dug pond was found infested on the winery property.

Although hydrilla was first found in a pond, all the ponds are downstream of and fed by an infested canal (Plate 11). Final eradication of the hydrilla in the ponds is not possible as long as the canal remains infested and can provide plant fragments to re-infest them. Therefore, the strategy has been to keep the populations in the ponds suppressed and under surveillance until the source infestation in the canal has been destroyed.

**2013 Surveys of Oregon House Ponds under Eradication**

Project staff visited most ponds two or three times in 2013, focusing on ponds that have had hydrilla in recent years. Visits were made at intervals in June, July, August and September. A few ponds received only one visit, as problems arose this year with ownership or property changes that affected access.

**Plate 11: Hydrilla Infested Ponds near Oregon House, and Hydrilla Infested Portion of Yuba County Water District Canal**

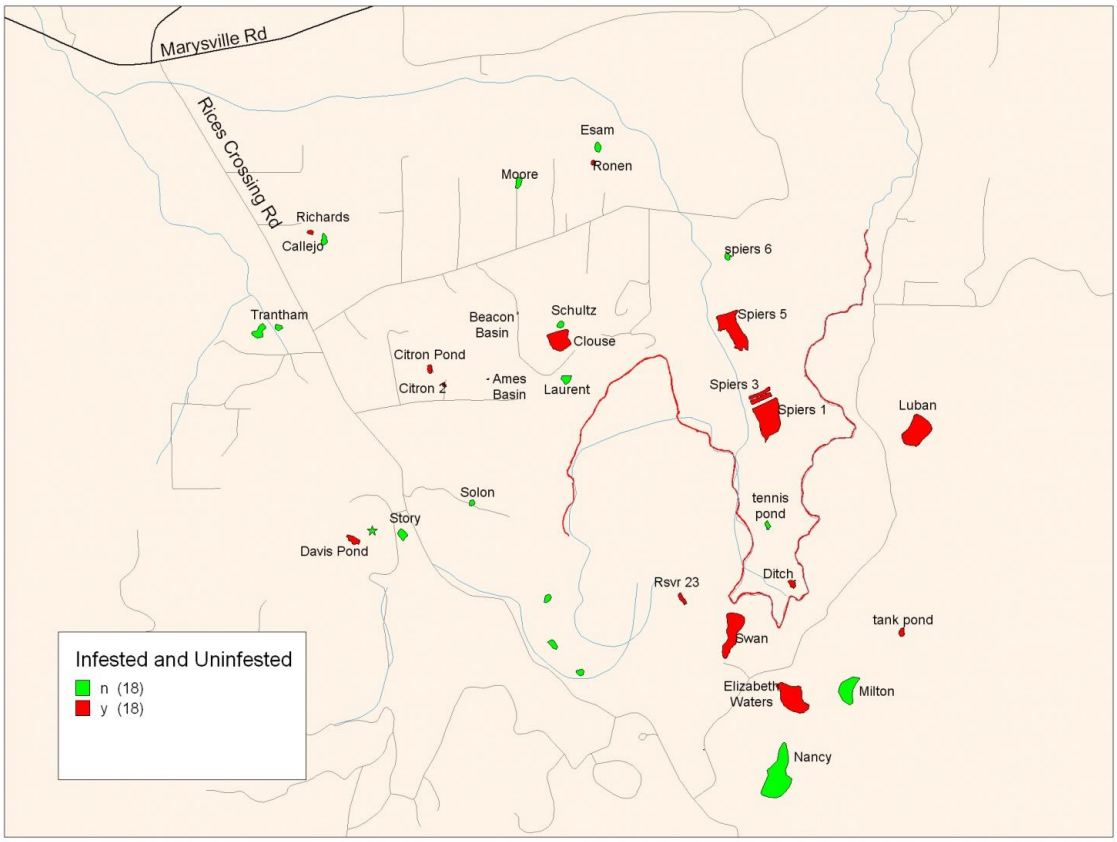


**Table 8: Presence (+) or Absence (-) of Hydrilla Plants or Tubers in the Yuba Ponds Near Oregon House, Yuba County 2000 – 2013**

| Hydrilla Detections (Plants or Tubers) in the Yuba County Ponds | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| YEAR | | | | | | | | | | | | | | | | |
| Pond Type | Pond Name | Pond Size (Acres) | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
| Irrigation | Ditch | 0.2 | + | + | + | + | + | + | + | - | + | + | - | - | - | - |
| | Reservoir 23 | 0.3 | + | + | + | + | - | - | + | - | - | + | - | - | - | - |
| | Tank | 0.2 | + | + | + | + | + | + | - | - | - | - | - | + | + | + |
| Non-Irrigation | Citron | 0.2 | + | + | + | + | - | + | + extremely heavy | + many | + many, small | + many, small | - lined | - | - | + |
| | Clouse | 1.9 | - | - | + | + | - | + | + | - | - | - | - | - | - | + |
| | Cornejo | | | | | | | | | + new | + | - | - | - | + | + |
| | Davis | 0.4 | + | - | - | - | - | - | + | - | - | - | - | - | + | + |
| | Elizabeth | 3.1 | + | - | - | - | - | - | - | - | - | - | - | - | - | + |
| | Luban | 3.0 | + | - | + | + | - | - | - | + very heavy | + | + | + | - | + | + |
| | Ronen | 0.1 | - | dry | dry | + | - | + | + | - | - | - | - | - | - | - |
| | Spiers 1 | 3.8 | + | + | + | + | - | + | + | - | - | - | - | - | - | + |
| | Spiers 2 | 0.5 | - | + | dry | dry | + | - | ?* | - | - | - | - | - | - | - |
| | Spiers 3 | 0.4 | - | dry | dry | dry | - | - | ?* | - | - | - | - | - | - | - |
| | Spiers 5 | 3.5 | - | - | - | + | - | + | + | - | - | - | - | - | - | + |
| | Swan | 2.7 | - | - | - | - | - | - | - | - | + | - | - | - | + | + |
| | Blacktop | 0.16 | | | | | | | | | | | | | + | + |
| | Trantham | 0.25 | | | | | | | | | | | | | | + |

*? = suspicious-looking plants but could not be hooked for confirmation.

Of the ponds used for irrigation, Ditch and Reservoir 23 had no hydrilla this year (See Table 8). Hydrilla was found in Tank Pond in August 2012 and 2013. Other aquatic vegetation noted during the surveys included coontail, egeria, Eurasian watermilfoil, and two forms of algae, nitella (Nitella species) and chara (Chara species).

In the ponds that are not used for irrigation, hydrilla was detected in five of them in 2012 and an additional six more in 2013 for a total of 11 of the non-irrigating ponds with current infestations (Table 8). Each pond has its own hydrilla history. In 2006, Citron Pond was heavily infested by mid season and new plant production occurred each following year until the pond was lined in 2010. The pond was hydrilla free from 2010 until 2013 when a few plants were found rooted in soil above the rim of the liner. Clouse Pond, which had over 50 plants in 2006, had been free of hydrilla for the last five years prior to the recent discovery of hydrilla in 2013. Davis Pond had been clear for five years after producing a few plants in 2006. A reinfestation was discovered in

Davis pond in 2012 and more plants again in 2013. In Swan pond a single hydrilla plant turned up in 2008. No plants had been found in either Swan or Elizabeth pond since 2008, until Swan was found re-infested in 2012 and 2013, and Elizabeth again in 2013. The four Spiers Ponds have been free of hydrilla for the last six years, including 2012, but in 2013 Spiers 1&5 were found to be reinfested. Luban Pond had been free of hydrilla for three years, but in 2007 at least one-third of the pond was very heavily covered by plants. Since the pond is isolated, the crew has been trying experimental treatments, occasionally using copper and fluridone if the population became too persistent. In 2009 less than 50 plants were sighted during the growing season, in 2010 only a handful of plants were found, and no plants were found in 2011. The infestation in Luban returned in 2012 and more plants were found in 2013. A newly dug Blacktop pond was discovered to be infested with hydrilla on the winery property in October, 2012 and again in 2013. The quarter-acre Tranthom pond was found to be infested in 2013. Ronen Pond and Spiers 2&3 remain uninfested.

**Treatment of Ponds within the Quarantine Zone**

Water bodies are treated according to the conditions observed in the ponds and management goals. The three irrigation ponds (Reservoir 23, Tank, and Ditch) are only treated with copper, to avoid damage to irrigated plants. Tank Pond was the only one with plants in 2012, and it was treated at about three week intervals with copper at 1 ppm in between early June and early September (Table 9). None of the non-irrigation ponds were treated in 2011 because they had not produced any hydrilla for four to five years. All of the ponds that showed hydrilla in 2012 and 2013 were treated with fluridone, or were scheduled for treatment next year if the find was late in the season. This included Luban Pond. We had been minimizing treatment in Luban for a few years because the pond is one of the few places left in California that has had significant densities of hydrilla within the last few years. There had been interest in trying some new herbicides in it that are candidates for being registered in California. However, with the lining of the canal now being so far advanced and the number of plants there so low, we are moving Luban towards an eradication footing and will be putting in full treatments. We will be moving all the ponds to full eradication.

**Table 9: Treatments to Water Bodies in the Oregon House Eradication Project, Yuba County, 2013**

| Water Body | Month Treated | Product | Active Ingredient | Target Concen-tration in Water | Notes |
|---|---|---|---|---|---|
| Black Top | May, July | Sonar SRP | Fluridone | 30 ppb | |
| Canal | June, Aug | Teton | Endothall | 2.5 ppm | |
| Citron | July, Aug | Sonar SRP | Fluridone | 30 ppb | |
| Clouse | June, July | Sonar SRP | Fluridone | 30 ppb | |
| Cornejo | Aug | Sonar SRP | Fluridone | 30 ppb | |
| Davis | May, July | Sonar SRP | Fluridone | 30 ppb | |
| Ditch Pond | | | | | Not treated |
| Elizabeth | | Aquatholl K | endothall | 2.5 ppm | test of new chemical |
| Luban | | | | | Not treated |
| Reservoir 23 | | | | | Not treated |
| Shakey's | May, Aug | Sonar SRP | Fluridone | 15 ppb | |

| | | | | | |
|---|---|---|---|---|---|
| Spiers 1 | June, Aug | Sonar SRP | Fluridone | 30 ppb | |
| Spiers 3 | | | | | |
| Spiers 5 | June, Aug | Sonar SRP | Fluridone | 30 ppb | |
| Swan | May, July | Sonar SRP | Fluridone | 30 ppb | |
| Tank | May, June, Aug | Komeen/Aquathol l K | Copper/Endothall | 1 ppm / 2 ppm | |
| Trantham | July, Aug | Sonar SRP | Fluridone | 10 ppb | Protecting large Koi fish |

**The Yuba County Water District Canal**

While surveying Oregon House in 1997 after finding hydrilla in a winery pond, the Project biologists found that the lowest 3.1 miles of an 18-mile irrigation canal were infested with hydrilla (Plate 21), in the area where it passes through the winery. In addition, two other small basins, which are used to transfer water from the canal, were also found to be infested (Ames (0.01 acres), and Beacon (0.02 acres)). The Yuba County Water District (YCWD) owns the canal and runs water in it between April and October. The canal is the source of hydrilla for all the ponds, thus eradication of the hydrilla in the canal is a requisite for eradication of the hydrilla in the ponds.

**Survey and Treatment of the Yuba Water District Canal**

From 1997 to 1999, Project biologists tried several treatment methods in the canal, with mixed results. A method to meter copper herbicide into the flowing water proved promising in 2000 and has been used ever since. The method uses electric pumps at three stations, one mile apart along the canal, to apply the herbicide to the water for four hours. The rate of application decreases from station to station to maintain a one-ppm concentration of copper along the canal. Visual observations in 2000 indicated that this method was relatively effective in controlling the hydrilla top growth. In 2006, the Project Biologist improved the delivery system for the copper herbicide so that the treatment duration could be increased from four hours to 12. Also, in 2000, project biologists started raking[24] and digging tubers in the canal, which has proved effective, though labor intensive and time consuming. In 2001, an acetic acid treatment was tried with promising results (Spencer, D. and G. Ksander, 2001), although the conditions required for treatment are so exacting that the method is not very practical. In 2012, the Project began to test treatments of the aquatic herbicide endothall, which has a new formulation with no restrictions on irrigation. Endothall is as effective as copper for hydrilla, and in addition seems to be much more effective on some other problematic plants such as elodea and pondweeds, which on occasion become so dense they interfere with project surveys.

**Lining of the Yuba County Water District Canal**

In April 2007, Program staff developed a $100,000 contract to line the most heavily infested section of the canal with concrete, in an attempt to put an end to this infestation. The contract was awarded on March 27, 2008, and provided for lining approximately 3,500 feet of the canal. Work began on March 31 and finished April 9. The contractor used a custom-designed bucket

[24] The rake method is simply to use a garden rake to sift the sediment in the canal bottom and sides to remove any hydrilla plants, tubers, roots, and root crowns. Screens are placed downstream of the raking operation to catch any floating hydrilla fragments.

on a four-wheel-drive backhoe to remove sediment from the canal and contour its profile, then sprayed three to four inches of concrete on the cleaned surface (see 2008 report for photographs). The work was challenging because of access issues, but was very well done.

The canal lining accomplished by the CDFA encouraged the Yuba County Agricultural Commissioner, Louie Mendoza, and his staff to work with the Yuba and Sutter Counties Weed Management Areas (WMA) and the canal company to continue the effort and try to line all of the most heavily infested parts of the canal, a total of about 9000 feet. They organized an effort to line another 1500 feet in April of 2009, with the help of a $20,000 contribution from the Hydrilla Program.

Since then the Agricultural Commissioner's Office and the WMA have continued organizing funds, including contributions from the Hydrilla Program. In 2011 all the different logistic and contract complications were overcome and the group lined 3,665 feet In October. With this effort, all but about 540 feet of the upper infested section of the canal will have been lined, and most of the most heavily infested sections have been covered. Another 930 feet were lined in October 2012. With this effort the heavily infested sections have been lined, and only a few plants are appearing each year in the canal. For at least a couple years, the Program will try to finish the rest of the eradication using survey and digging of plants and tubers.

Lining of the canal definitely helped with the reduction of plants and tubers. The crews removed 2,696 tubers and plants in 2005 and 1,175 in 2006, but they found only 170 in 2007, approximately 100 in 2008, and only about 20 plants in 2009. The heavily infested sections of the canal were lined with concrete in 2008 and 2009, which helped contribute to the few plants found in 2009. All plants were dug out in 2009, so no copper treatments were made that year.

Three years after lining the canal in 2008, some stretches of the lined section started to develop deposits of soil and organic matter. Visits to the canal suffered through the middle part of 2010 because of the effort put into lining Citron pond, so the canal went six to eight weeks without a visit. Visits began September and continued monthly through November, turning up about 20 plants again in 2010. All plants were dug out, with an effort made to find the tubers. From 2011 through 2013, the canal was surveyed every few weeks from June through September. Several small patches of hydrilla plants were found in 2013, and dug out. During the late winter and early spring of 2013 when the ditch was not being used for irrigation, crews were able to use a mini excavator to remove heavy sediment accumulation. Runoff pushes sediment off the steep hills which accumulates on top of the concrete lining allowing hydrilla fragments and tubers to live on top of the liner. Fortunately any plants growing in this sediment are kept from reaching the soil beneath the liner and are easily removed with the sediment. During the irrigation season a mud pump was successfully used to remove the sediment while irrigation water was flowing. In the winter of 13/14 efforts will be made to address the sediment reaching the ditch.

**Yuba County Water District Canal Transfer Basins**

The two transfer basins for the canal, Ames and Beacon, also have a history of hydrilla. Plants were detected in Ames in 2003. The irrigation district dug out this basin with a backhoe in 2004 and no plants were found that year. Two plants were found and removed in 2005, but none were found in 2006 and 2007. A few plants appeared in 2008 and 2009, and all were dredged out to remove any tubers. A few plants appeared again in 2010. In 2011 two or three square yards of the basin were found covered with plants and the biologist took care while removing them to not send fragments of hydrilla downstream.

In 2012, a few plants once again appeared in the basin. Project biologists and the canal company decided to replace the basin with a set of pipes and manifolds. The biologist obtained the parts for the system during the season and the canal company installed them during the winter when water deliveries were suspended for the season. With the water now completely enclosed in pipes the basin no longer functions as a holding area.

The Beacon holding basin is concrete-lined and was cleaned of all sediment and hydrilla by Project biologists in January of 2002. No hydrilla has been detected there since.

In addition to hydrilla, Project biologists found several other aquatic plants in the canal, including elodea, American pondweed, sago pondweed and cattails. In places, the population levels are quite high, making survey difficult and interfering with treatments. The plants also develop a heavy cover of algae, which complicates survey and treatment.

**Shakey's Pond, Survey and Treatment**

Dr. Lars Anderson (USDA-Agricultural Research Service) reminded Program staff in late August, 2007, that Shakey's Pond had been infested, although the infestation had been declared eradicated about 2002. When the Oregon House biologist went to survey the pond, he found small clumps of hydrilla scattered among very dense stands of other aquatic weeds such as egeria. Treatments began in about a week.

The heavy plant biomass originally in the pond would have interfered with the hydrilla taking up fluridone. Accordingly, Project biologists used copper to quickly take down the mass of plants. However, killing too much biomass at one time can cause oxygen depletion and lead to a fish kill. To minimize that possibility, the biologist treated one-third of the pond at a time at a concentration of 1 ppm of copper in each treated area. No fish mortality was noted. The copper treatments cleaned up the pond very thoroughly, and the biologist applied two treatments of fluridone at 45 ppb during October 2007.

Water samples taken early in the 2009 treatment season revealed that the pond holds fluridone concentrations well. One treatment of fluridone at 45 ppb was applied in June, 2010, and water tests in spring of 2011 showed there were still effective levels in the pond. No fluridone was added to the pond that year. The pond was surveyed three times in 2011 in July, August, and September and twice in 2012, in August and September. No plants were found in 2011 but one sickly plant was found in September 2012 and removed by hand. The pond was then treated with fluridone at 45 ppb. Prior to 2012, the last plants appeared 2009, when three plants were found. They were small and sickly and were removed with tubers attached. One plant was found in 2013. A single application of 15 ppb fluridone was made.

**Trantham Pond**

In July 2013 a maintenance worker from North Yuba Water District was doing work on a pipe nearby the pond and reported some suspicious looking plants growing in it. Hydrilla was verified within a week and contact was made with the land owner. Due to concern for long lived ornamental Koi fish and low water levels in the pond, low rates of 10 ppb fluridone were applied in July and August. Repairs to the water delivery pipes resulted in significant increase in the water level. Following the second application the hydrilla plants were visibly affected by the herbicide and the Koi were unharmed.

## GENERAL DETECTION SURVEYS

The Fresno Hydrilla Program crew conducts hydrilla surveys as part of the general aquatic plant detection program. Specific bodies of water and areas are targeted under this general detection program, but any waterway in which work is conducted also gets a thorough look. No hydrilla was detected in 2013.

Waterways visited:

Fresno County: Mendota Wildlife Area, north and south of Hwy. 180

Fresno/Madera Counties: The San Joaquin River, starting three miles upstream of the Hwy. 41 bridge all the way to, and including, Mendota Pool; Fort Washington, Sportsman, Milburn and Borba ponds, all adjacent to the San Joaquin River.

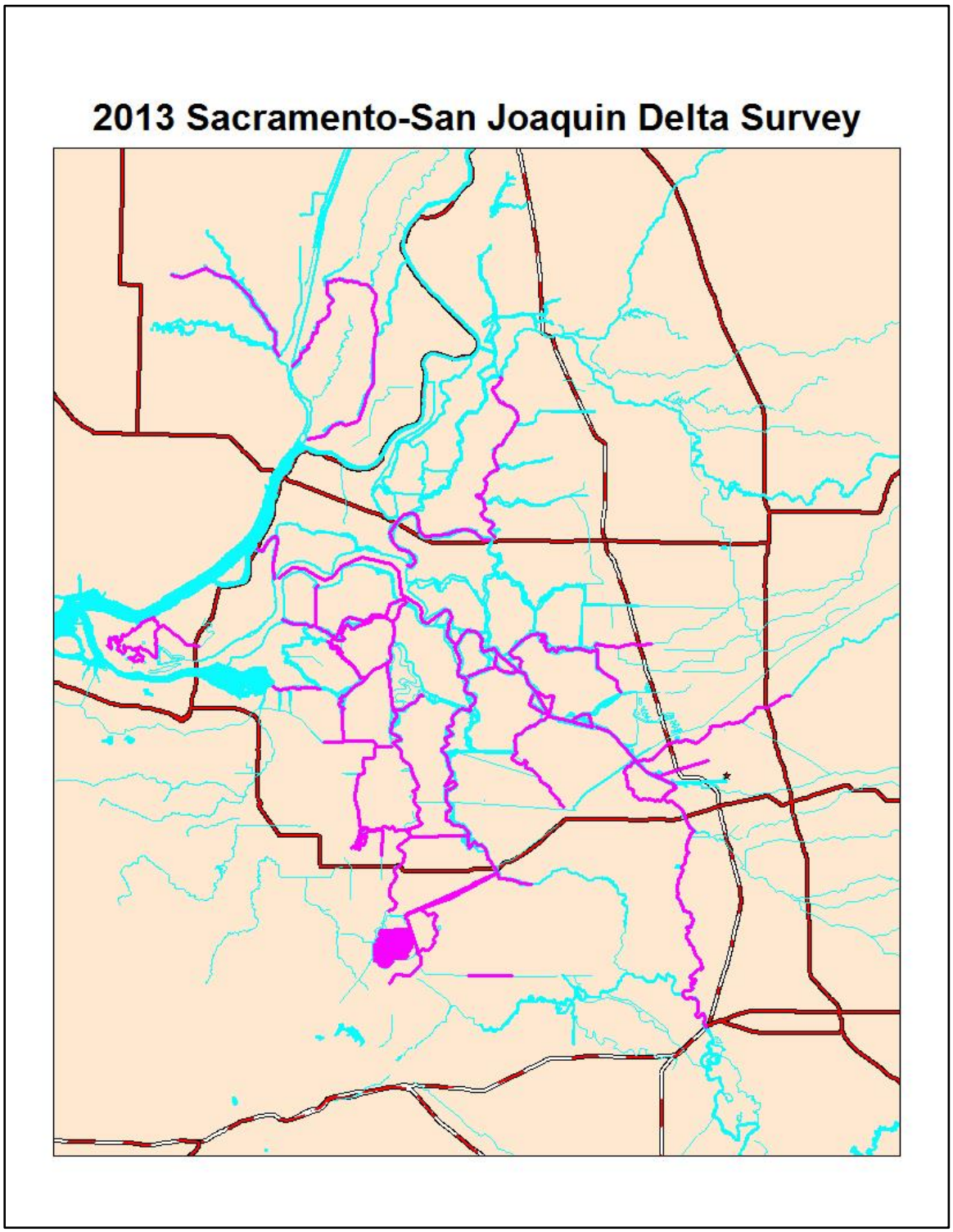
Madera County: Bass Lake, Eastman Lake

Merced County: Los Banos Reservoir, O'Neill Forebay, Salt Slough in San Luis National Wildlife Refuge, the Merced River at Hagamon County Park on Hwy. 140 and at George Hatfield State Recreation Area, the San Joaquin River at Grasslands State Park, Hwy. 140

Shasta/Tehama/Colusa Counties: Spot checks in the Sacramento River – Red Bluff City Park, Mill Creek Park, Tehama County Park, Bidwell-Sacramento State Park, Colusa-Sacramento River SRA, two access points on Hwy. 145 between Hwy. 162 and Hwy. 120, and Black Butte Lake

Tulare County: Lake Success

**Plate 12: Waterways surveyed in the Sacramento-San Joaquin Delta**



**The Sacramento-San Joaquin River Delta Survey**

Starting in the mid-1980's, CDFA personnel have conducted an annual survey of the Sacramento-San Joaquin River Delta and the lower reaches of the tributary rivers for hydrilla[25]. Traditionally, this survey was conducted in September when hydrilla mats could have reached the surface, but staffing and other resource issues necessitated the survey be conducted at various times from June through September.

Fresno and Sacramento staff used small watercraft to thoroughly survey marinas, small channels and sloughs, and the major waterways. The small, surface drive watercraft allowed closer access to shore, boat slips, and into areas with high aquatic weed presence. No hydrilla was found.

**Waterways:**

Miner Slough, Steamboat Slough, Cache Slough, South Mokelumne River, 3 Mile Slough, Fisherman's Cut, False River, Frank's Tract, Piper Slough, Sherman Lake, numerous stretches of the San Joaquin River/Deep Water Channel, Dutch Slough, Sand Mound Slough, various stretches of Old River and Middle River, Holland Cut, Columbia Cut, Disappointment Slough and Ward Island, Pixley Slough, Bear Creek, Turner Cut, Whiskey Slough, Rock Slough, Orwood Cut, Indian Slough, Discovery Bay, Woodward/North Victoria Canal, Victoria/North Canal, Clifton Court, around Coney Island, Calaveras River, Smith Canal, Burns Cutoff, San Joaquin River between Stockton and Mossdale Crossing

**Marinas:**

River's End, Discovery Bay, Tracy Oasis, Village West, Tower Park, Westgate Landing, Whiskey Slough, Tiki Lagun, Turner Cut

**Aquatic Plants Seen:**

Algae, American pondweed, azolla, cabomba, cattails, coontail, curly leaf pondweed, duckweed, egeria, elodea, water hyacinth, Eurasian watermilfoil, parrotfeather, water pennywort, water primrose, sago pondweed, small leaf pondweed, South American spongeplant, tules.

**SOUTH AMERICAN SPONGEPLANT (*leads: Patrick Akers and Florence Maly*)**

The CDFA occasionally gives the Hydrilla Program responsibility for other newly introduced, invasive aquatic weeds. One recent example is giant salvinia, which has been eradicated from within the state. Similarly, beginning in about 2004, the Hydrilla Program began work on South American spongeplant (*Limnobium laevigatum*). This species behaves much like water hyacinth or giant salvinia except it reproduces heavily from seed, as well as producing new plants by budding. Until 2007 the effort was quite small. Spongeplant was limited to one small pond in the Redding area where it responded well to treatment. Beginning in 2008, however, new, separate infestations started appearing in waterways and spreading in several parts of the

[25]The Delta carries 47 percent of all the runoff water in the state. It provides water for residential, industrial, and agricultural uses in both the north and south state areas. The Delta supports approximately 120 fish species, approximately 750 plant and animal species, and is the largest wetland habitat in the western United States (CALFED Bay-Delta Program 2001). The annual survey of the Delta was partially initiated in response to recommendations made by the Scientific Advisory Panel convened in 1988 to consider the hydrilla infestation in Calaveras County (Stocker, R.K. and L.W.J. Anderson *et. al.* 1988).

Central Valley, particularly the San Joaquin Valley. The increasing problems warrant including the plant in this report.

Spongeplant could very well present a threat to California much like water hyacinth. However, it seems to spread much more easily in canals and other water infrastructure than hyacinth, so it may become a more widespread and persistent problem. Nonetheless, hydrilla is the Program's priority, and the increasing number of infested sites is straining the Program's ability to address the new pest.

South American spongeplant presents something of a paradox as far as eradication is concerned. On the one hand, in any one location, even small crews can make significant progress and reduce populations to very low levels, even over long stretches of water. If an infestation is caught early, before the plants set many seeds, often plants never come back after an area is thoroughly cleaned. On the other hand, the plant seems to be leapfrogging about, appearing in locations that have apparently minor connections. Its small, abundant seedlings seem to move much more easily than water hyacinth. Also, once a location has been heavily infested and the plants have set seeds, infestations take a long time to kill out, as the seed bank appears to last at least four years. As a result, sometimes the situation looks very hopeful, other times it looks fairly hopeless, and the outlook can change in a few days' time.

**Infestations by water system name and detection year:**

2007 San Joaquin River
Salt Slough
2008 Cameron Slough/Byrd Slough
San Luis Canal Company/Henry Miller Reclamation District
Central California Irrigation District
2010 CDFW North Grasslands Wildlife Area, Salt Slough Unit
Grasslands Water District
Patterson Irrigation District
2011 San Luis National Wildlife Refuge
2012 Two new infestation sites, both associated with CCID Main Canal.
Cameron Slough extended approximately 1.5 miles.
Grasslands Water District San Luis Canal extended a couple miles.
**2013 F&W, North Grasslands Wildlife Area, China Island Unit**
**Foothill College, Santa Clara County**

**San Joaquin River:**

South American spongeplant was first confirmed in the San Joaquin Valley in August 2007 in the San Joaquin River in Fresno. Program crews initiated delimitation surveys and found plants in patches of various sizes and stages of development, in ponded and slow moving stretches of the river, starting approximately three miles upstream of Highway 41 and stretching downstream to Highway 145, a distance of around 20 miles. Up to 60 miles of river are usually dry below Highway 145. During the 2007 season, the CDFA crews identified the upstream limit of the infestation and hand removed approximately 90 percent of the biomass from there downstream to Highway 99, a distance of about 11 miles. Work continued in 2008, 2009, and 2010, with plant removal continuing down to Highway 145, again removing at least 95 percent of the biomass. In summer of 2009 water flows increased from Friant Dam into the San Joaquin, marking the start of an attempt to restore salmon to the river. The first releases for the restoration project pushed the flow up to a high of 2000 cfs for a brief time. Previously, releases ranged between less than 100 cfs to approximately 350 cfs. The increased flows perhaps

pushed spongeplant further downstream, but it also left plants high and dry when the water receded, effectively killing them.

In January 2011, there was a large release of water (over 6,000 cfs for a couple of days) which caused major flooding of previously dry areas. The river flow did not decrease to a safe level for survey activities until August. We feared finding large numbers of plants, both in the original channels and in newly created channels as well. This was not the case. While the main river channel had changed in some places, there were no new large ponded areas. Further, there were no large mats of plants. In the river channel proper, plant numbers were so low they could be counted individually. The crew removed approximately 3,900 plants from the channel. Five isolated ponds accounted for approximately 15,000 plants. Numbers above about 100 are visual estimates, but the crew members are now highly experienced with different densities of plants. No plants were found downstream of Hwy. 99 to Modoc Ave. This was the farthest downstream point we could survey because in early November the water release from Friant Dam was greatly reduced and the river went dry somewhere west of Modoc Ave. The crew checked the river bed from San Mateo Ave. up to the Chowchilla Bypass, where the water was in small pools; no spongeplant was seen.

Access to the river was limited by high water flows in 2012. During these periods crews worked every stretch between the infestation source down to just below Hwy 145. The majority of plants removed were from the three mile section starting below Hwy 41 in Fresno. This area had the heaviest concentrations of plants at the start of the infestation, so it is not surprising to see the higher numbers here. Of the 26,500 plants removed from the river this year, approximately 95 percent were from three isolated ponds and a side channel. No spongeplant was found in Mendota Pool, which is the main water source for many of the canals west of the river, or in the river downstream of the Pool.

In 2013 work in the San Joaquin River was again hampered by high water releases from Friant Dam. Access was limited in the main river channel, allowing plants to grow and reproduce by budding. This resulted in more plants removed from the main channel than in 2012, but the plant populations in the isolated ponds that accounted for most of the plants last year were greatly reduced. Two isolated ponds and one side channel produced 9,700 of a total of 22,215 plants in the river system.

For the first time since the discovery of spongeplant in the San Joaquin crews were able to survey the river from the source of the infestation all the way to Mendota Pool. No spongeplant was detected beyond one mile downstream of Highway 145. No spongeplant has ever been detected in Mendota Pool. Spot checks were made in the San Joaquin River at various access points from Firebaugh to Stockton, and no spongeplant was detected.

**Kings River area east of Fresno:**
Spongeplant was discovered in January 2008 in a small canal (Cameron Slough) arising from the Kings River east of Sanger in Fresno County. Delimitation surveys discovered the source pond (about 0.1 acres) and determined that the infestation covered only approximately two miles of Cameron and a short distance of an associated canal, Byrd Slough. The source pond was also cleaned out in February 2008. Since that time, seedlings have been removed shortly after germination, stopping any new seed formation. The pond outflow is also screened, which catches most seedlings before they can enter the canal. In the canal, six weeks of intensive hand removal in winter 2008 reduced the biomass by 90 percent, and by 98 percent by the end

of the year. Eradication efforts continued through 2009 and 2010. Very few plants were detected in the last survey of 2010. Spongeplant was never found in the Kings River itself.

Hydrilla Program personnel pumped mud out of the bottom of the source pond in October2011. The pumping probably removed thousands of seeds and seedlings. Its effectiveness was demonstrated by the decrease in the appearance of seedlings. After the pumping less than 100 seedlings were removed before the end of the year. Prior to the pumping we were removing about 500 seedlings every three weeks.

The source pond for the Cameron infestation continued to produce seedlings throughout 2012. Approximately 2700 seedlings were removed. No plants were allowed to mature and produce seeds.

The Cameron Slough infestation increased another 1.5 miles in 2012 with the discovery of two large patches and some scattered plants downstream of the lowest previously recorded plant site. Crews removed 7500 plants from Cameron, with the two patches accounting for approximately 85 percent of that total. Control structures were installed in key points along the slough to prohibit further downstream movement. No spongeplant was found in Byrd Slough in 2012.

In 2013 swift water in Cameron Slough prohibited surveys until September. During September and October 800-900 plants were removed from the slough, mainly from previously heavily infested sites. Very few plants were found at the sites of the two large patches discovered in 2012, and no plants were found between the last two control structures downstream.

The source pond continues to produce seedlings, but at significantly lower numbers; in 2013 only 700 seedlings were detected and removed.

Byrd Slough had 55 plants this year, but none escaped to the associated lateral canal.

**San Luis Canal Company/Henry Miller Reclamation District:**
An infestation covering a few hundred feet was discovered in a small end canal in June 2008. By the end of July this infestation was eradicated, with no return of plants. In 2010 additional infestations were found in other canals and drains in the system. An infestation found in Salt Slough in 2007 may have come from the SLCC/HMRD system, which is upstream of the Slough.

Extensive survey and mapping of the district occurred in 2011. A few relatively small infestations were found. The district did not allow the Program crew to remove the plants, for fear of liability. However, the district did increase their spraying and dredging activities and were able to reduce these infestations.

In 2012, there was one thorough survey of the entire district, and it revealed zero spongeplant. The District personnel dredged many of the waterways, including most of the prior plant sites.

The entire district was surveyed in 2013 and no spongeplant was detected.

**Central California Irrigation District and related waterways:**
In November 2008, the CDFA was notified of yet another infestation, this time in northwestern Fresno and southwestern Merced Counties between Mendota and Dos Palos, in canals and drains of the Central California Irrigation District (CCID). This large water system extends over

three counties (Fresno, Merced and Stanislaus) and its Main Canal runs for approximately 76 miles between Mendota Pool and Crows Landing. Many scattered plants and limited spot infestations were eliminated in a number of these canals, usually within two to three months of the find. Major portions of Main Canal have been dredged by the CCID, removing plants and, hopefully, seeds.

Infestation levels in 2011 were less than 30 percent of that seen in 2010. The Irrigation district dredged more canals and drains, and sprayed plants where the CDFA crews could not hand remove them.

The CCID canals are the likely source of infestations discovered in 2010 in the Grasslands Water District and the North Grasslands Wildlife Area canals. With these discoveries, spongeplant has now been found well north of Los Banos.

In 2012 fewer miles of canal, and fewer overall sites had continuing infestations. However, two new sites adjacent to the CCID Main Canal were discovered. These sites, a small isolated pond and a small feeder canal, plus the Cebro farmer side drain found in 2011, accounted for the majority of the 29,000 plants and additional 5 cubic yards of material removed from the CCID system this year.

Major improvements in the CCID system were seen in 2013. No new sites were detected and the Main Canal only had one flare-up at a previously heavily infested site. Crews were able to remove the 800 plants that appeared. Zero plants were detected in the isolated pond and small feeder canal discovered in 2012, and in all the other previously infested CCID canals.

**Patterson Irrigation District:**
In October 2010, a small infestation was discovered in the central canal of the Patterson Irrigation District system. PID personnel reported that they eliminated all the plants by the end of 2010.

Quick surveys of the infested area in March 2012 and July 2013 did not find any plants.

**San Luis National Wildlife Refuge:**
This infestation was discovered in July 2011. Two canals and a large marsh were heavily infested. By year's end, all plants had been removed by the CDFA crew and Refuge personnel. Plants were too numerous to count but the estimates are that several tons of biomass were removed.

The two canals and the marsh were de-watered, dredged and burned in mid 2012. Water was placed back in the waterways in early November. No spongeplant was detected in 2012 or 2013.

**Grasslands Water District:**
The Irrigation District attempted to bring this infestation under control themselves, but the spongeplant grew so fast that their spray program could not keep up with it. The Hydrilla crew removed square yards of plants to bring the infestation to a point where the district could manage it.

The waterways in this district require consistent attention to maintain control. The 2,500 plants removed were scattered throughout the various canals. Unfortunately, plants did appear to move farther downstream, albeit in very small numbers.

In 2013 a major supply canal, the San Luis Canal, was de-watered to conduct repairs. In addition to lateral canals in the Grasslands Water District, this canal feeds the Fish and Wildlife Grasslands Canal. No spongeplant was detected in the entire Grasslands Water District system, nor the F&W Grasslands Wildlife Area, Salt Slough Unit following refilling the San Luis Canal.

**Cebro Drain:**
The drain is a farmer's small side channel located adjacent to the CCID Main Canal. The owner committed to spraying every two weeks and the Program crew placed some booms to keep plants out of the Main Canal. However, at year's end there were still many small plants. This waterway required consistent attention in 2012 to keep it under control. It was infested for some time before it was discovered so there is undoubtedly a large seed bank.

Plant numbers in Cebro Drain are beginning to decline. Only 2,285 seedlings were removed in 2013. The control structures are preventing plants from entering the Main Canal.

**CA Fish and Wildlife, North Grasslands Wildlife Area, China Island Unit:**
In February 2013 the North Grasslands WA Manager noticed an infestation of spongeplant in a riparian channel in the China Island Unit. The infestation was delimited in March and April; no connection to any other infestation was discovered. By mid-April all plans and permits were in place and the infestation was put under treatment activities, including use of diquat, hand removal and placement of control structures to contain the infestation and keep it from moving into Mud Slough or the San Joaquin River. As evidence of how fast spongeplant can grow, the infestation doubled in size between March 22 and April 18. Treatment and removal activities continued in May and by early June no more spongeplant was detected. The channel was de-watered in mid-summer and by September was almost completely dry. When water was again allowed in the channel in December, no spongeplant was seen. Weather conditions were such that spongeplant would have been able to thrive had there been any remaining seeds. Project staff believes this was a very new infestation and therefore no seed bank was established.

**Foothill College, Santa Clara County**
Project staff was notified of a spongeplant infestation in a small concrete pond on the Foothill College campus in Santa Clara County. The pond is used for biology classes and was planted with various aquatic plants. State and County personnel removed all the potted plants, floating algae and a few spongeplants from the pond and bagged the material for disposal. The pond will be monitored for signs of remaining spongeplant, but it is believed that all seed material was removed and the infestation is eradicated.

**Sacramento Delta:**
No work was done by Program personnel on spongeplant in the Delta in 2012, except for a couple short surveys to check the population status around Decker Island. Encouragingly, that population remained small, at least by the time of the survey in early August. Less encouraging, reports from other agencies working in the Delta indicated the spongeplant was spreading farther in Frank's Tract, especially in the southwest corner.

Extensive aquatic plant surveys took place in the Delta in 2013. Spongeplant was detected in small numbers in Indian Slough outside Discovery Bay; Piper Slough, southwest side of Frank's Tract; near Ward Island off the Deep Water Channel; the San Joaquin River west of Fisherman's Cut; Middle River south and north of Columbia Cut; and in Old River at the northeast corner of Rhode Island. Sites that had been located by other agencies in 2012 were

checked, and in most cases no spongeplant was seen. The patches do move with tidal flows, and perhaps even with boat traffic.

## SUMMARY AND CONCLUSIONS

In 2013 the CDFA Hydrilla Eradication Program continued its momentum towards achieving eradication of hydrilla across California. Since 2010, we have reached eradication in four separate projects (Chowchilla/Eastman, Bear Creek, Mokelumne Hill, Springville Ponds). In three other projects, there have been no plants for five to six years and we have moved to the post-treatment confirmation survey phase (Redding golf course, Anderson Park, two of the three ponds in Nevada County). The irrigation drains in Imperial County appeared to be free of hydrilla the last 3 years with the last plants seen in the canals in the 1990's. Hydrilla was found in only three projects (Clear Lake, Oregon House, one small pond in Nevada County).

Clear Lake took a bounce along the bottom this year. More plants were found this year than last (26 vs six), but only in five spots. If the source plants for the three colonies had been found before they were fragmented, there might have been only five plants this year instead of 26. But detection of individual plants in Clear Lake will continue to present major challenges and there will almost certainly be some misses that take some time to discover. Since there is no high-tech, high-speed way to pinpoint single hydrilla plants, the only method to improve survey results is to increase survey effort, and resources are constrained for that. Despite the survey challenge, overall infestation levels in the lake are trending towards extinction. Further, with the leveling off in treatment area, there is reason to hope that the project will remain within the budget available to the Hydrilla Program.

With the lining of 3,700 feet of the Oregon House canal in 2011 and 930 feet in 2012, that infestation is starting a clear trend towards eradication. Less than 20 to 30 plants have been found in the canal in each of the last few years, and all the ponds are being put on a treatment regime to move them to eradication. With the piping of Ames Basin in the winter of 2012-13, another stubborn little source of infestation will be removed, which otherwise could have reinfested all the downstream ponds.

While the eradication projects made progress this year, the effort to survey for new hydrilla introductions has suffered some in the past four years, especially north of the Delta. This is due to the demands of Clear Lake and recent cuts to the weed programs in the CDFA. These factors led first to the loss of the seasonal crew in Redding, then to the Clear Lake crew focusing all its efforts on the lake with no time for detection surveys, and finally to the loss of the weed biologist in Redding. Many resources for detection were lost with these changes. In the Delta and San Joaquin Valley, survey continues at a good pace, which also provides us some opportunity to survey for and work on spongeplant. The CDFA and county biologists continue to survey the critical Sacramento / San Joaquin River Delta. Once again, survey crews detected no hydrilla plants in the Delta in 2013.

The CDFA Hydrilla Eradication Program has been a cooperative effort since the first discovery of hydrilla in Lake Ellis in Marysville in 1976. The Governor, Legislature and the CDFA recognized the threat hydrilla posed for the State of California and quickly instituted the legal framework needed to eradicate this noxious weed. With the support of many cooperators, the CDFA Hydrilla Eradication Program has been successfully conducting survey, eradication and public education efforts ever since.

In conclusion, the CDFA's Hydrilla Eradication Program is helping to protect California's waterways by keeping them free of an especially invasive, noxious, aquatic weed. Continued diligence in survey and public outreach, and rapid response to any new detection, are keys to the success of this effort. The CDFA Hydrilla Eradication Program would like to thank its supporters and cooperators for aiding in its success.

## COOPERATORS

The CDFA Hydrilla Eradication Program would like to thank all of its cooperators and supporters. The CDFA has received financial support, manpower, regulatory support, and/or technical assistance from the following: the California Department of Boating and Waterways, Center for Spatial Technologies and Remote Sensing, California Department of Water Resources, United States Army Corps of Engineers, United States Department of the Interior-Bureau of Reclamation, United States Department of Agriculture-Agricultural Research Service Exotic and Invasive Weed Research Unit, the Yolo County Flood Control and Water Conservation District, Lake County Department of Public Works, Imperial Irrigation District, Nevada County Transfer Facility, and the Alameda, Calaveras, Contra Costa, Imperial, Lake, Los Angeles, Madera, Mariposa, Nevada, Orange, San Joaquin, Santa Barbara, Shasta, Tulare, Ventura and Yuba County Agricultural Commissioners.

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**Thank you to CDFA Hydrilla Eradication Program staff Patrick Akers, Michelle Dennis, Jonathan Heintz, Florence Maly and Mike Meske for their assistance in preparing this report**.